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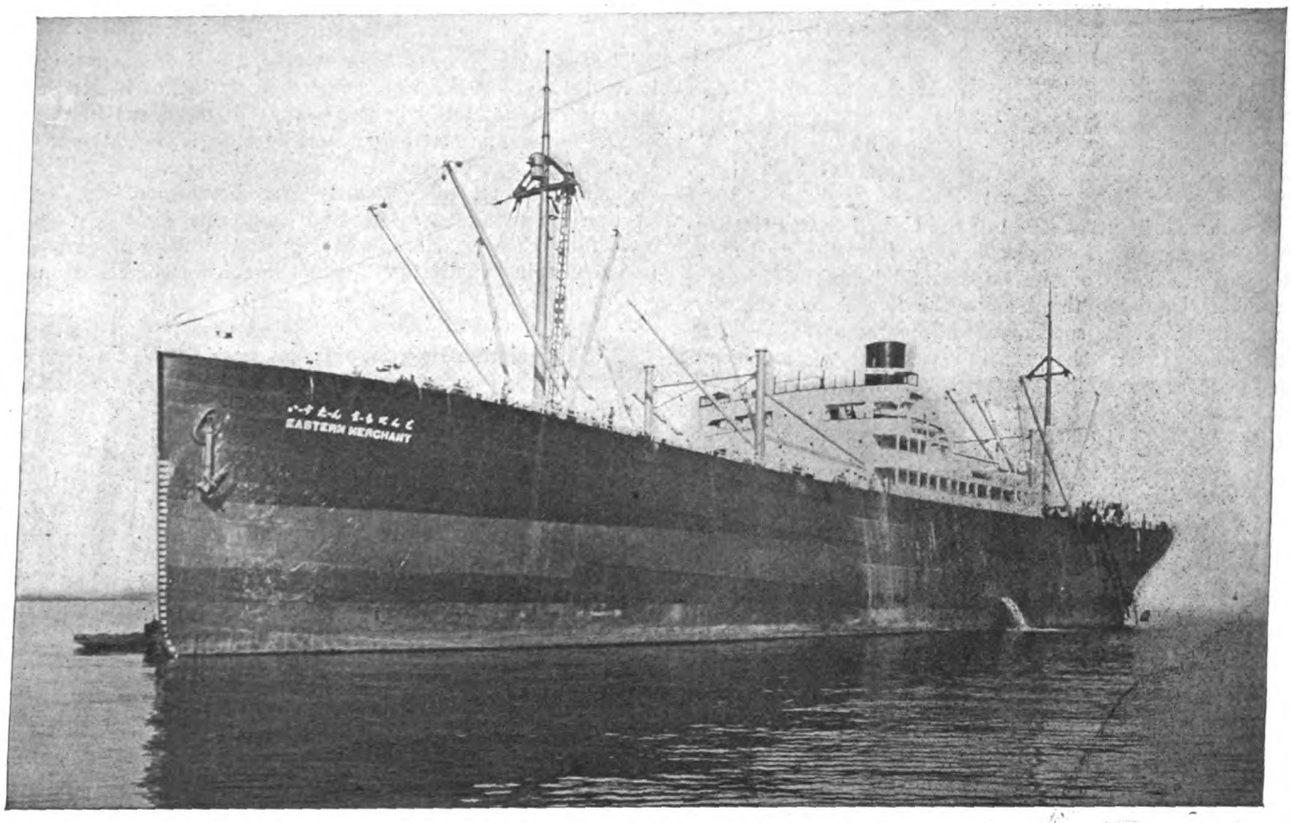

Fig. 1.— S. S. *Eastern Merchant* Nearly Completed

Twin Screw Cargo Ship Eastern Merchant

13,000-Ton Deadweight Freighter Built by the Asano Shipyard, Tsurumi, near Yokohama, Japan, for the United States Shipping Board

BY C. ANO*

DURING the late war, Japanese shipbuilders suffering from a lack of steel materials negotiated with the United States Government to build cargo steamers for them and to get steel in return. As a result of these negotiations two series of contracts were arranged between the United States Shipping Board and representatives of the Japanese shipbuilders.

The first series of contracts, which were signed during April, 1918, provided for the sale of twelve steamers of 100,800 tons deadweight by the Japanese shipbuilders at the rate of $225 to $275 per deadweight ton and for the release for export of 100,800 tons of steel already ordered by the Japanese shipbuilders from the various steel mills in the United States. The shipbuilders concerned in these contracts were the Asano Shipbuilding Company, Kawasaki Shipbuilding Company, Osaka Iron Works, Suzuki Company and Uraga Dock Company. Most of the ships under these contracts were, at the time of signing the contracts, ready for sea or in an advanced state of building, and contributed great assistance to the Allies in carrying war materials across the Atlantic. Later on three steamers having a total deadweight capacity of 27,000 tons were added to this series of contracts by the Kawasaki Shipbuilding Company.

The second series of contracts were signed in May, 1918, and their principal terms provided that the Japanese shipbuilders were to build and supply the ships to the United States Government at the rate of $175 per deadweight ton and that the United States Government was to supply the builders with half as many tons of steel material as the deadweight tonnage of the ships they supplied.

* Director and chief draftsman, Asano Shipbuilding Company.

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Following is the complete list of the shipbuilders and number and tonnage of the ships they are building under these contracts:

Builders	Number of Ships	Deadweight Tonnage of Each Ship	Total Deadweight Tonnage
Asahi Shipbuilding Company	1	5,500	5,500
Asano Shipbuilding Company	2	13,000	26,000
Fujinagata Shipyard	1	6,300	6,300
Ishikajima Shipbuilding and Engineering Works	2	5,000	10,000
Kawasaki Shipbuilding Company	5	9,000	45,000
Mitsubishi Shipbuilding Company	2	8,400	16,800
Mitsui Company (Uno Shipyard)	2	9,100	18,200
Nitta Steamship Company	1	5,500	5,500
Osaka Iron Works	4	10,500	42,000
Suzuki Company (Harima yard)	1	5,000	15,500
Suzuki Company (Harima yard)	1	10,500	
Uchida Shipbuilding Company	2	8,500	17,000
Uraga Dock Company	3	6,650	19,950
Yokohama Dock Company	3	6,300	18,900

In spite of the great effort of the United States Government in arranging for quick delivery from the steel mills, none of the keels of the ships could be laid before the armistice. Among those ships the two Asano steamers are considered fine specimens of Japanese naval architecture, being the largest and only twin screw vessels built in Japan for the United States Government. The description of the first ship, *Eastern Merchant,* given herein will be sufficient to give a general idea of both ships.

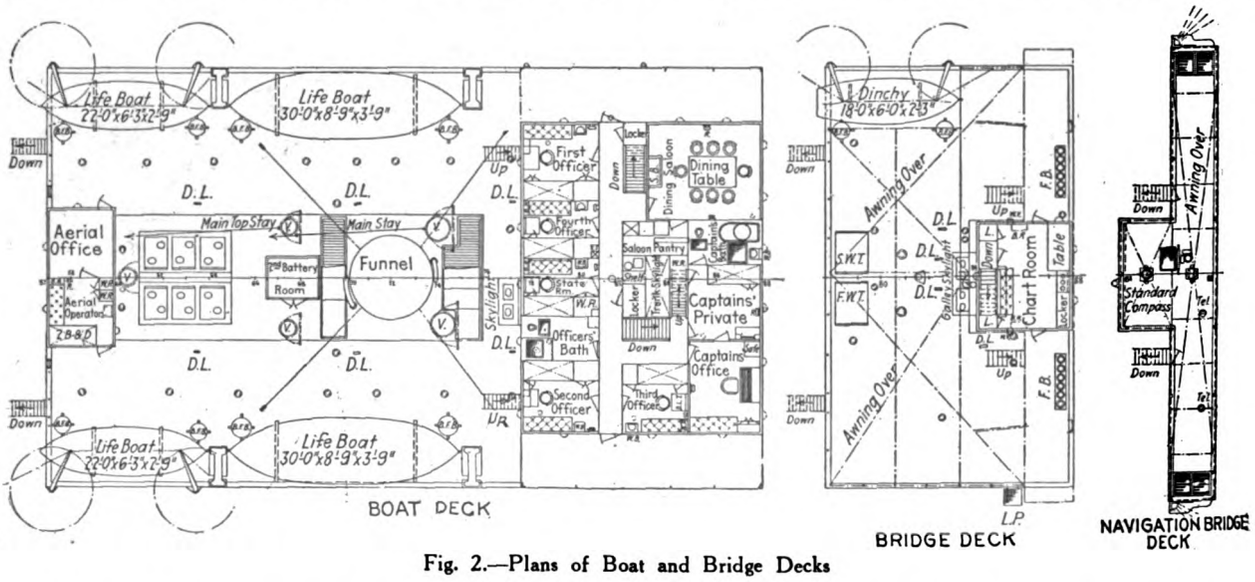

Fig. 2.—Plans of Boat and Bridge Decks

Principal Dimensions

The principal particulars of the *Eastern Merchant* are as follows:

Length overall	461 feet	7 inches
Length between perpendiculars	445 feet	0 inches
Breadth, molded	58 feet	0 inches
Depth, molded to shelter deck	40 feet	1 inch
Load draft	30 feet	4 inches
Gross tonnage	8,194 tons	
Net tonnage	4,988 tons	
Deadweight capacity	13,000 tons	
Capacity for bale cargo at 40 cubic feet	14,000 tons	

General Arrangement

The general arrangement is shown in the accompanying plans, from which it will be seen that the steamer is of the shelter deck type with three continuous decks, which are of steel throughout. Above the shelter deck there are steel deck houses to accommodate the officers and crew, the top of the midship house being extended to form a boat deck. There are seven steel watertight bulkheads, four of which extend to the shelter deck, and the others to the upper deck. A cellular double bottom extends the full length of the ship between the peak bulkheads, all of which will be used for the stowage of fuel oil, except the part under the engines, in which reserve feed water will be carried. The fore and aft peak tanks are also arranged for fuel oil. The total capacity of the fuel oil tanks, including the large settling tanks, is 1,768 tons, which will give the ship a steaming radius of about 11,000 miles.

Framing

The vessel is framed transversely, the frame spacing being generally 36 inches, reduced to 27 inches in No. 1 hold and to 24 inches in the peaks. Plate floors in the double bottoms are arranged on alternate frames, the intermediate floors being of bulb angle section, supported by flanged bracket plates. Widely spaced pillars of tubular section are arranged in the holds and tween decks, thus providing clear spacious holds for the storage of cargo. No side stringers are fitted except in the forward portion.

Accommodations

Accommodation for the officers and engineers is as shown on the illustration. The house on the boat deck is allotted exclusively for deck officers, the port side of the midship house for engineers, the starboard side for the steward and petty officers, and the after deck house for the exclusive use of the seamen and firemen, each quarter having a spacious and well equipped mess room. The saloon, captain's and chief engineer's cabins have been given special attention, the rooms being very tastefully finished in Japanese oak and pine. All officers' and crew's rooms are spacious, well ventilated and lighted and have been arranged to suit the special requirements of the American owners.

Cargo Handling Arrangements

The loading and discharging arrangements are of a very efficient character. Eighteen wooden derricks and one heavy steel derrick are provided to load and discharge cargo through six large hatchways, with the aid of 7-inch by 12-inch double geared horizontal steam winches. As will be seen in the accompanying plan, the two steam winches forward of No. 2 hatch are arranged for heavy lifts to work on a large lifting drum placed on the ship's centerline, through forged steel clutches, and with the topping arrangement leading to a similar drum connected to the No. 1 winches. This arrangement enables a quick and safe working of cargoes of large weights.

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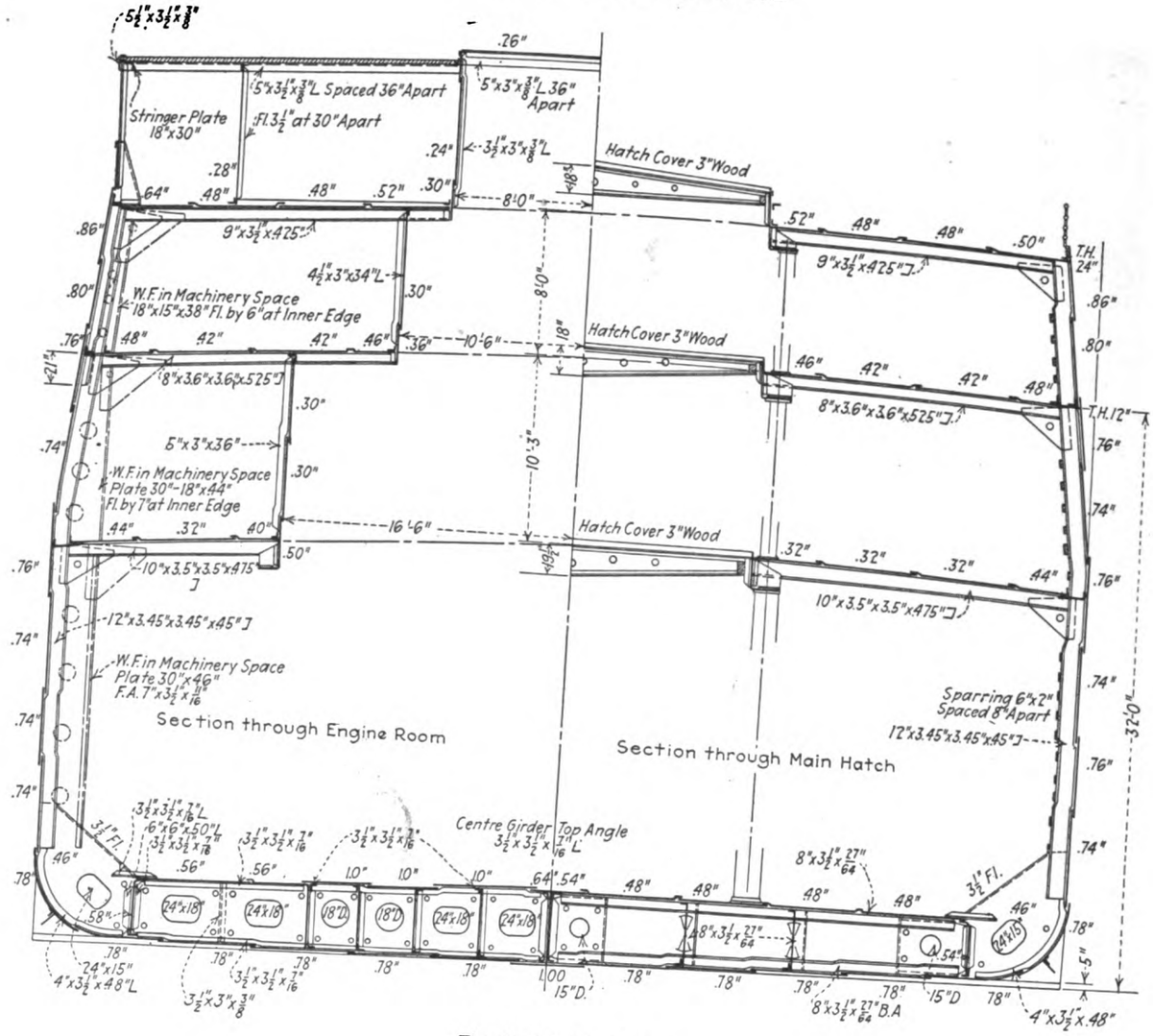
Stringer Plate 18"x30"
W.F. in Machinery Space 18"x15"x38" Fl. by 6" at Inner Edge
W.F. in Machinery Space Plate 30"-18"x44" Fl. by 7" at Inner Edge
W.F. in Machinery Space Plate 30"x46" F.A. 7"x3½"x11/16
Hatch Cover 3" Wood
Hatch Cover 3" Wood
Hatch Cover 3" Wood
Section through Engine Room
Section through Main Hatch
Sparring 6"x2" Spaced 8" Apart
Centre Girder Top Angle
24"x18"
24"x15"
15"D.
15"D

Fig. 4.—Midship Section

ANCHOR HANDLING

There is a powerful spur geared anchor windlass and a capstan engine aft for anchoring and mooring purposes. The bower anchors are of the Ohshima patent stockless pattern and are stowed in the hawse pipes.

STEERING GEAR

The steam steering engine is of Brown's patent steam tiller type actuated from the bridge through telemotor gears. An electrical rudder head telltale is provided so that any disturbance in the telemotor system can be readily noticed by the officer on watch. The ship has been arranged for the installation of wireless apparatus, but this has not been fitted by the shipbuilders.

PROPELLING MACHINERY

The propelling machinery of the ship consists of two sets of triple expansion engines, constructed by the Kubota Iron Works of Osaka. The particulars of each main engine are as follows:

Diameter of high pressure cylinder	22 inches
Diameter of intermediate pressure cylinder	36½ inches
Diameter of low pressure cylinder	61 inches
Stroke	48 inches

There are two main condensers, each having a cooling surface of 2,700 square feet. Each of the propellers has four detachable manganese bronze blades with a cast iron boss. The diameter and pitch of the propellers is 16 feet and 18 feet respectively.

Steam is generated by four single ended return tube boilers working under Howden's system of forced draft. The particulars of the boilers are as follows:

Diameter	14 feet 3 inches
Length	11 feet 6 inches
Working pressure	200 pounds per square inch
Grate area	58.2 square feet
Heating surface	2458.8 square feet

The engine and boiler room auxiliaries include the following:

Auxiliary condenser: One, of 600 square feet cooling surface.
Circulating pumps: Two sets, centrifugal type.
Independent feed pumps: One pair, size 10½ inches by 8 inches by 24 inches.
Independent bilge pump: One, size 6½ inches by 6½ inches by 6 inches.
Ballast pump: One, size 9 inches by 12 inches by 10 inches.
General service pump: One, size 10 inches by 6 inches by 10 inches.
Oil shifting pump: One, size 10 inches by 7 inches by 10 inches.

In addition, there is a 20-ton evaporator, an ash hoisting engine, a feed water heater, etc.

The ship is lighted throughout by electricity. Two dynamos, one of 25 kilowatts capacity and one of ten

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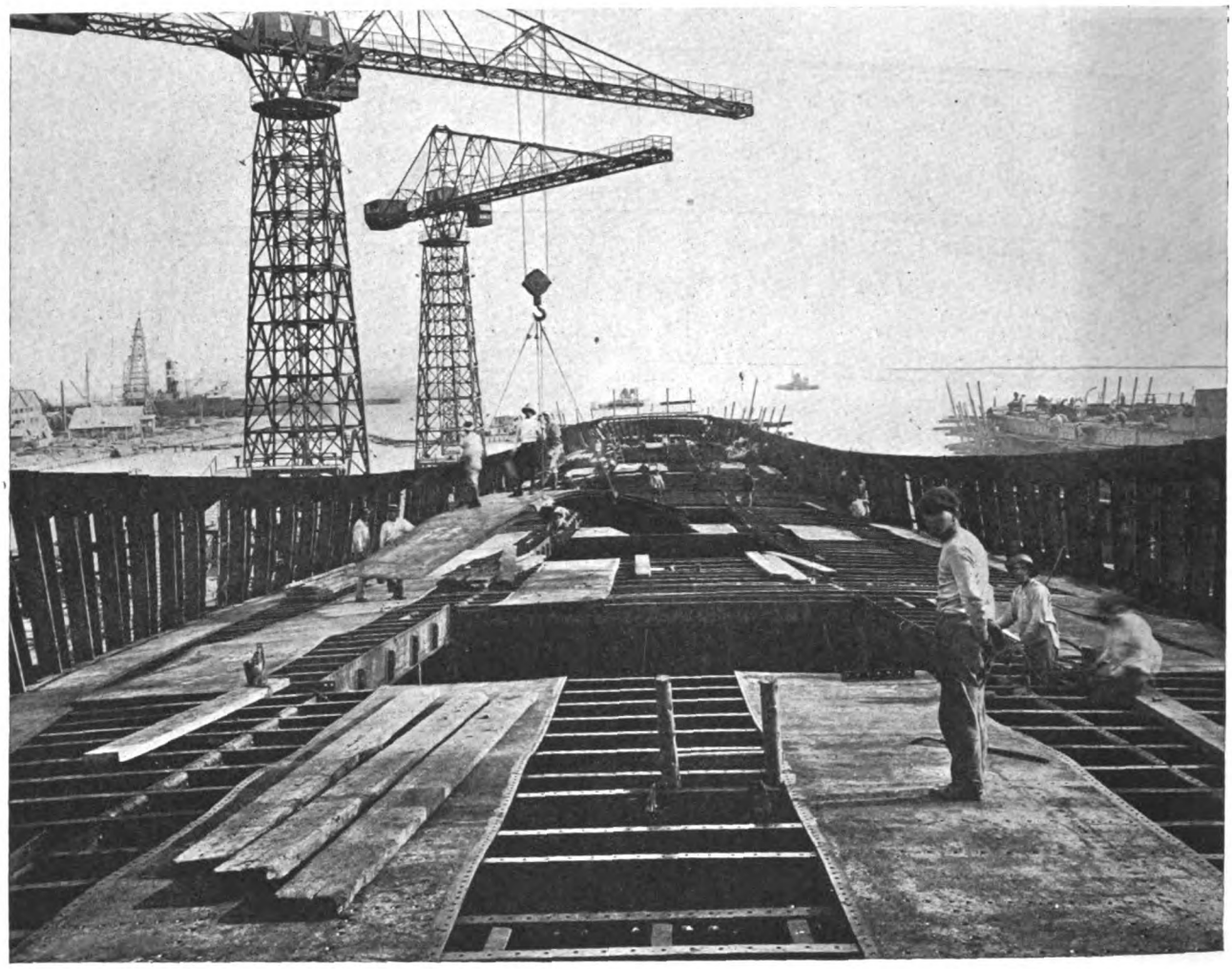

Fig. 5.—*Eastern Trader* Under Construction

kilowatts capacity, are placed in the engine room for this purpose. Space for cold storage and ice machines was provided, but these are to be installed in the United States after the vessel is delivered.

TRIALS

The steam trials of the *Eastern Merchant* and her sister ship *Eastern Trader* were very successful and satisfied both the owners and the shipbuilders. On the light load steam trial the *Eastern Merchant* attained a mean speed on double runs of 15.46 knots, while the *Eastern Trader* made 16.15 knots. Afterward the former ship easily made a mean of 12.7 knots on a six hours' continuous run with a total deadweight of over 11,000 tons on board, every part of the machinery being kept in normal working condition. Thus these ships proved themselves not only the largest but the fastest among the ships built in Japan for the United States Government.

The keel of the *Eastern Merchant* was laid on April 21, 1919, and that of the *Eastern Trader* on May 1, 1919. Both ships had several alterations during the construction, and were launched on October 6 and November 4 respectively. Both ships had steam trials during December of the same year and were handed over to the United States Government early in February, 1920, at San Francisco.

Steamship Eudunda Launched at Australian Naval Dockyard

A FURTHER stage in the progress of the Australian Commonwealth shipbuilding programme was reached on March 29 when the steamship *Eudunda* was launched from the Commonwealth Naval Dockyard, Cockatoo Island. This vessel is the first of the improved shelter deck type to take the water. Her principal dimensions are as follows:

Length between perpendiculars	331 feet 0 inches
Breadth, molded	47 feet 9 inches
Depth, molded to upper deck	26 feet 1 inch
Load draft	23 feet 8 inches
Indicated horsepower	2,300
Boilers (Babcock and Wilcox)	3
Speed	10½ knots

The vessel is built to Lloyd's classification on the Isherwood system of framing and has a double bottom extending from the forward collision bulkhead to the after peak. The double bottom, except under the boiler room, is arranged for stowage of oil fuel, it being anticipated that the vessel will be required to burn coal or oil during her period of service.

A complete shelter deck is fitted, thus adding considerably to the deadweight carrying capacity of the vessel,

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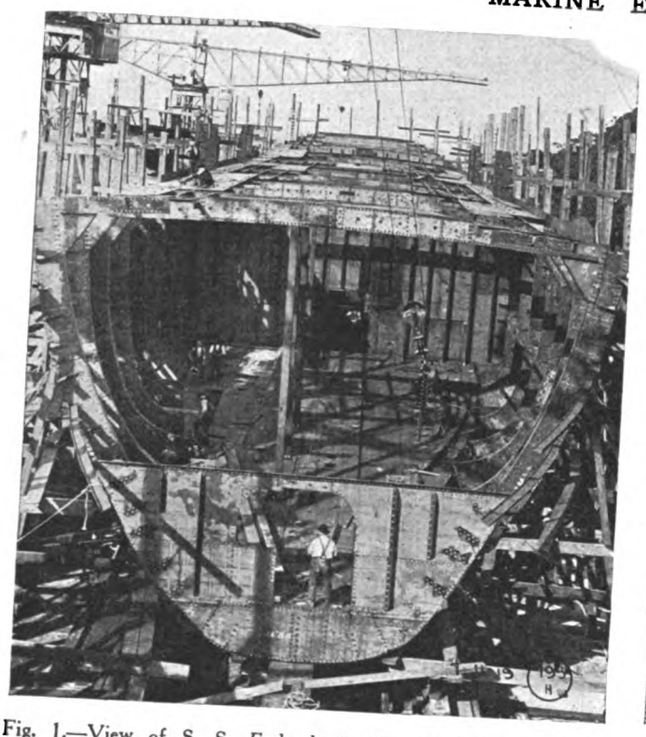

Fig. 1.—View of S. S. *Eudunda* in Course of Construction at Commonwealth Naval Dockyard, N. S. W.

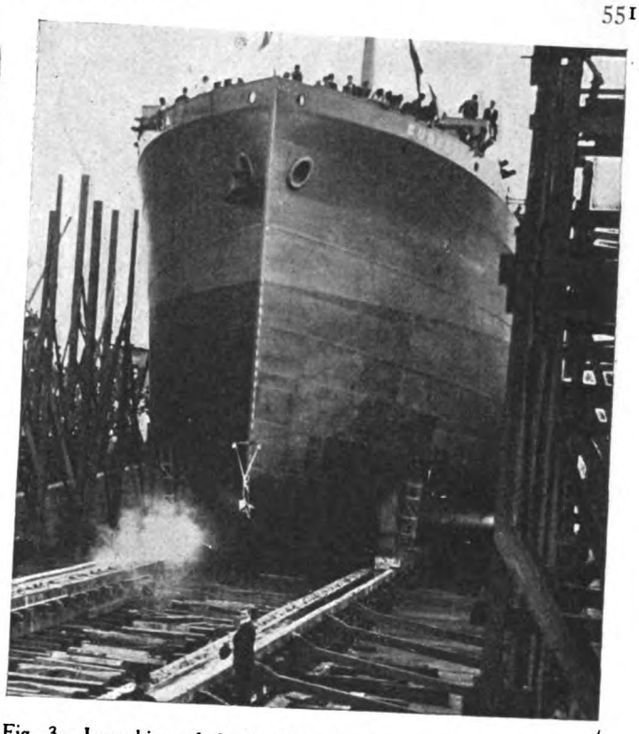

Fig. 3.—Launching of S. S. *Eudunda*, Naval Dockyard, Sydney, N. S. W., on March 29, 1920

which now becomes 6,000 tons as against 5,500 in the earlier vessels.

Accommodations throughout are arranged in accordance with the latest requirements of the Navigation Act. The officers' quarters are on the bridge deck. The captain's quarters with the wireless operator's and wireless room, are on the lower flying bridge. The seamen and firemen are berthed aft on the upper deck. The joiner work is of Australian timber and all fittings are first class throughout.

A refrigerating room for carrying of food supplies for the ship's company is installed on the upper deck. The vessel is lighted throughout with electricity and all cabins are steam heated. The piping arrangements are very complete and include an efficient system for dealing with the oil fuel.

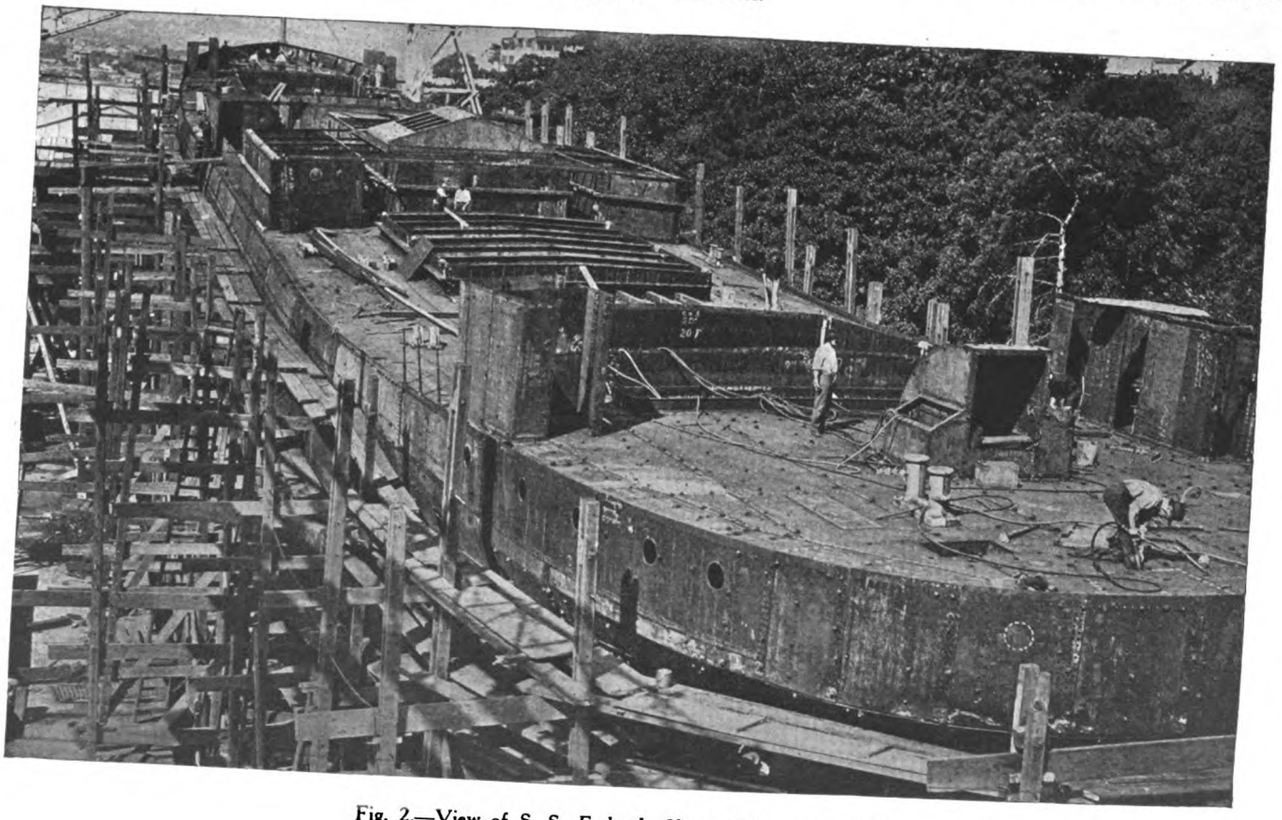

Fig. 2.—View of S. S. *Eudunda* Shortly Before Launching

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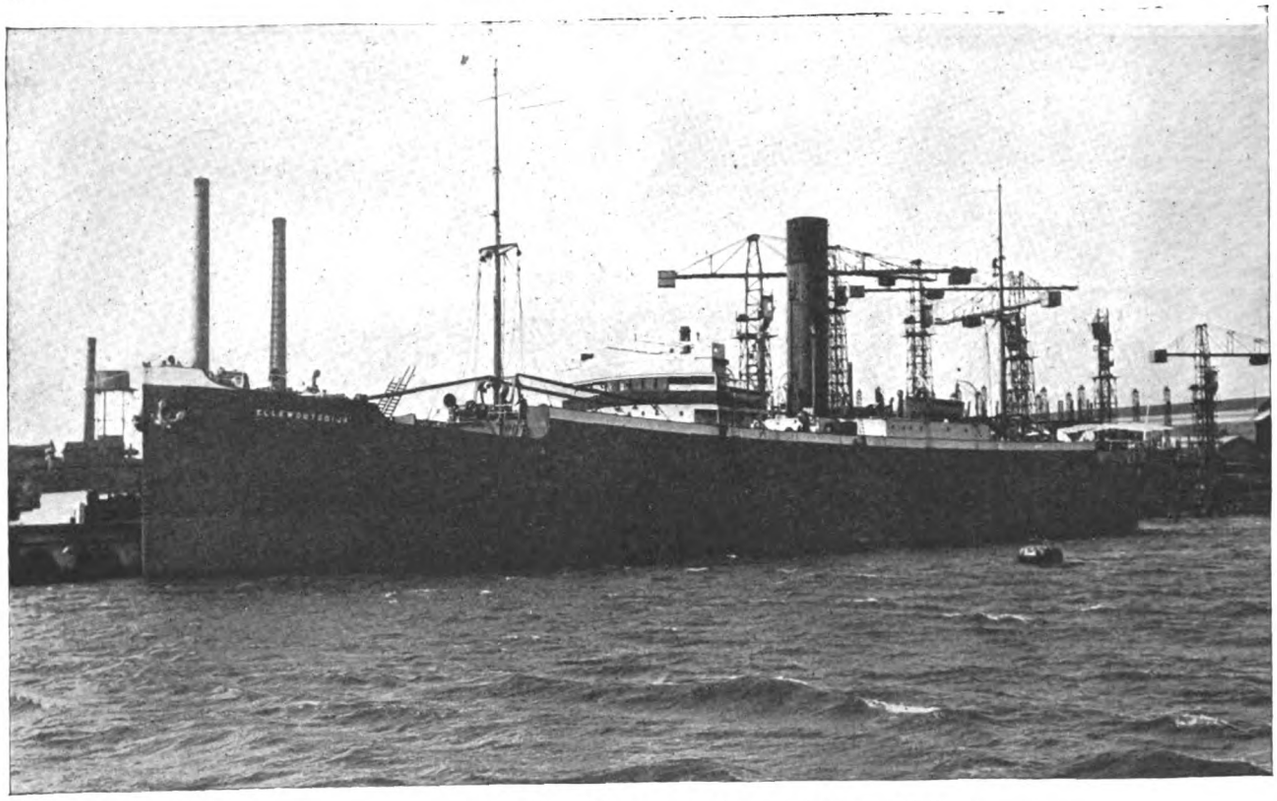

S. S. *Ellewoutsdyk*, Built at Werf Gusto Works, Schiedam, Holland

Cargo is handled by eight 5-ton steel lattice work derricks carried on the foremast and mainmast and a 20-ton steel derrick, which is provided for dealing with heavy weights. Eleven steam winches are fitted, viz., eight 7-inch by 12-inch winches at main cargo hatches; one 7-inch by 12-inch winch aft, having an extended main shaft with couplings and brackets and fitted with warping drums, and two 7-inch by 12-inch winches amidships for the cross bunker hatch.

It is interesting to note that these winches, together with the windlass, steam steering gear and other auxiliary machinery and fittings are of Australian manufacture, the winches and windlass being supplied by the Perry Engineering Company, of Adelaide, and the steam steering gear by Messrs. P. Jorgenson & Sons, Bendigo. The manufacturers of the refrigerating machinery are Messrs. Wildridge and Sinclair, Ltd., of Sydney, and various makers throughout the Commonwealth are supplying the remainder of the equipment.

The engines are of the usual triple expansion vertical marine type, developing 2,300 indicated horsepower, manufactured by Messrs. Thompson & Company, of Castlemaine, Victoria. There are three Babcock and Wilcox boilers, having a heating surface of about 8,000 square feet.

New Dutch Steamship

THE latest vessel turned out by the Werf Gusto Firma A. F. Smulders, Schiedam, Holland, is the cargo steamer *Ellewoutsdyk* built for Messrs. Solleveld vander Meer & T. H. van Hattum's Steamship Company, Rotterdam. The *Ellewoutsdyk* is a single deck vessel with long bridge and poop, built according to the highest classification of Lloyd's, 100 A-1, under the supervision of the Dutch shipping and harbor authorities. She has a length of 359 feet 3 inches, a beam of 50 feet, and a depth of 24 feet 6 inches. On a draft of 21 feet 7½ inches the vessel has a deadweight carrying capacity of 6,300 tons, her gross tonnage being 3,683, and the net tonnage 2,239.

Six watertight bulkheads divide the hull into seven compartments, four of which are cargo holds. The capacity of each is as follows:

	Grain, Cubic Feet	Bales, Cubic Feet
Hold 1	76,950	71,630
Hold 2	96,570	90,530
Hold 3	58,690	54,730
Hold 4	47,820	43,330
Bridge, forward of casing	42,170	36,880
Bridge, at side of casing	10,460	8,220
Bridge, aft of casing	25,620	22,320
Forecastle	6,070	5,220
Total capacity	364,350	332,860

The bunkering capacity is 793 tons, including the spare bunker under the bridge. The capacity of the water ballast tanks, including the fore and aft peaks, is 1,130 tons.

Officers' quarters are situated under the bridge and above or along the engine casing. The crew is berthed in the poop. Separate hospitals are provided for the officers and crew.

The vessel is propelled by a triple expansion engine with cylinders 25 inches, 41 inches and 67 inches diameter by 45 inches stroke, designed to develop 1,800 indicated horsepower. Steam is supplied at a pressure of 180 pounds per square inch by three coal-fired Scotch boilers, each 13 feet 9 inches diameter by 10 feet 5 inches long. Both propelling and auxiliary machinery were manufactured at the Werf Gusto works. The auxiliaries include an electric generating set of 7 kilowatts capacity, which provides current for lighting the vessel and also for the wireless equipment.

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Passenger Steamer for the Newcastle-Bergen Route

AN important event in the progress of British reconstructive shipbuilding took place on May 4 at the Walker shipyard of Messrs. Sir W. G. Armstrong, Whitworth & Company, Limited, of Newcastle-on-Tyne, when a steel screw passenger vessel for Det Bergenske Dampskibsselskab, Bergen, was launched. Mrs. Lee, Lady Mayoress of Newcastle-on-Tyne, gracefully named the vessel S. S. *Leda*. The *Leda*, which is to run between Newcastle and Bergen, forms a powerful addition to the company's fleet. She is a finely modelled steamer with slightly larger accommodation and more speed than the S. S. *Jupiter*, which up to the present has been the fastest steamer in this service.

The principal dimensions are as follows:

Length overall	321 feet 2½ inches
Length between perpendiculars	305 feet 0 inches
Breadth, extreme	41 feet 9 inches
Depth, molded	20 feet 6 inches
Mean load draft	17 feet 0 inches

The vessel is of the two deck type, with combined poop and bridge, joined to the forecastle by means of two permanent gangways, the shell being carried up in way of the forward well to the line of the forecastle. A promenade deck extends for about one-half length amidships, covering the midship house, while above this is the boat deck, at the fore end of which is placed a house containing the accommodation for the captain and principal deck officers. An after boat deck covers the house containing the steering gear, third class entrance and seamen's entrance.

Passenger Accommodations

The vessel is fitted out for about 100 first class passengers, in one and two-berth rooms, placed on the upper and second decks. These staterooms, which are large and airy, are fitted up in first class style and are in every way suitable for the comfort of the passengers. A large dining saloon is fitted up at the fore end of the bridge deck, having seating accommodation for all passengers. The main entrance of this dining saloon is carried up to the promenade deck, from which opens a spacious lounge. The decorative work and fittings of the saloon, lounge and entrances are of elegant finish, the work being designed and carried out by Messrs. Trollope & Colls, Ltd., of Liverpool. The whole of the first class accommodation is such as will appeal strongly to those crossing from Great Britain to Norway.

On the upper deck aft, accommodation is arranged for forty-seven third class passengers in two, four, five and six-berth cabins, with two comfortable dining rooms, one on the upper deck, the other in the house on the poop deck. An open air café is arranged at the aft end of the promenade deck.

Officers' and Crew's Quarters

On the bridge deck around the engine and boiler casing are housed the engineers and junior deck officers; here also are the mail room, post office, etc. Accommodation for the stewards and stewardesses is arranged at the after end of the first class accommodation on the upper deck. The firemen are berthed on the second deck at the sides of the engine casing, and the seamen on the second deck aft.

Construction and Equipment

The vessel is built to the highest class of Norske Veritas and will be the first vessel in the North Sea to comply with the requirements of the London Convention for Safety of Life at Sea. The regulations of the Norwegian Board of Trade for passenger vessels have also been complied with. Ample water ballast capacity is arranged for in double bottom, deep tanks, side tanks and fore and aft peaks, ensuring an equally good sea boat in the loaded condition. Three cargo holds are arranged, each served by double derricks and double winches, so that cargo can be quickly shipped and unshipped. The ventilation arrangements are of the most up-to-date type. The first and third class accommodation, seamen's and firemen's accommodation are ventilated and heated on the thermo tank system and arranged so that the air in each room may be continuously changed. Special insulation is fitted to keep the various rooms at a uniform temperature in the coldest weather, and also to guard against overheating from the machinery and boilers.

The deck machinery is of the latest type, the steering gear of Caldwell's make being fitted on the rudder head, with telemotor control from the wheelhouse amidships. The vessel is fitted with electric light throughout, having duplicate plants, together with emergency lighting and pumping arrangements, as required by the London Convention. Marconi wireless installation is also fitted. The cooking and serving arrangements are of the very best description, designed so that food can be well and quickly served. The various regulations to guard against fire are being fulfilled, while lifesaving appliances are in accordance with the latest requirements of passenger vessels. Lifeboat accommodation is arranged for every person on board.

Propelling Machinery

This vessel is of the single screw type, with turbine machinery driving the propeller shafting through gearing. The turbines consist, for going both ahead and astern, of a high and low pressure turbine, working in series. These turbines transmit their power through flexible couplings to pinions, which in turn drive the gearing, which is of the double reduction type. This type of gearing makes possible a speed of rotation which is best suited both to the turbines and the propeller, resulting in a high overall efficiency being obtained. At the same time, the revolutions of the propeller are about the same as would be obtained by machinery of the reciprocating type, the total reduction of speed between the turbines and propeller being effected in two steps.

When working at full power on service it is anticipated that the turbines will develop about 2,800 shaft horsepower at about 115 revolutions per minute. The impulse type of turbine having wheel stages throughout has been adopted; the grouping is such as to produce practically an equal transmission of power through the high and low pressure turbines. The adoption of high and low pressure turbines for going astern produces an arrangement which is conducive alike towards greater efficiency and immunity against total breakdown. The rotating portions of the turbines comprising the stage wheels and the spindles have been made entirely from ingot steel forgings, while the blading throughout is of phosphor bronze material.

The gear wheels and pinions are of the double helical type, the shape, size and pitch of teeth being made in accordance with what experience has proved to be satisfactory. The wheel rims upon which the teeth are cut, together with the main shafts, are made from ingot steel forgings, while the pinions are of nickel steel.

Lubrication and Auxiliaries

For the efficient and silent running of such gearing it is necessary that the means of lubrication should be as thorough as possible. For this purpose sprayer nozzles, distributed at suitable intervals, are arranged to spray

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the oil direct onto the engaging teeth, thereby providing a film of oil between the surfaces in contact. All other bearings in connection with the turbines and gearing also work under a system of forced lubrication.

The Michel type of thrust bearing is used both in connection with the adjusting of the high and low pressure turbines and the main thrust block.

The condensing plant is made capable of maintaining a vacuum of 28½ inches, with the temperature of sea water at 60 degrees F. when the machinery is developing its full service power. A very complete installation of auxiliary machinery is provided to cope with the whole of the engine room and deck requirements of a vessel of this class. This includes an auxiliary condenser of suitable size.

BOILERS

The boilers are of the multitubular type, single ended and three in number. They are arranged for working with Howden's system of forced draft. The working pressure of the boilers is 220 pounds per square inch. An approved type of superheater is fitted in connection with the boilers, and the temperature of the superheated steam entering the turbines is about 200 degrees F. in excess of saturated steam. Special attention has been paid to the provision of suitable materials which come in contact with the superheated steam, both in the boiler and engine rooms, and considerable attention has been given to the insulating of all hot surfaces, by the provision and application of special non-conducting materials. A fan arranged for driving by two engines, one being a stand-by, is fitted for supplying the air for the forced draft. The stack is of oval section with outer casing, which is carried the full height.

Ample and well directed ventilation is provided for both the engine and boiler rooms. The machinery throughout has been built to the Norwegian Veritas classification for a passenger vessel, and it also complies with the requirements of the London convention. The new vessel will be a great acquisition to the owners' fleet, and will without doubt rapidly become popular with the traveling public.

Vessels of the Forest Lumber Fleet

Five-Masted Barkentine Rigged Sailing Vessels, Especially Designed for Lumber Trade, Being Built in Pacific Coast Yards

THE wooden sailing vessel, because of its comparatively low operating cost, still has a section of the carrying trade almost exclusively for its own. Where the time element does not enter the question of transporting a cargo, the sailing vessel enters the field in fair competition with the steam- and the motor-driven ship. In the case of lumber carrying, this fact is particularly true, and many ships are at present building along the Pacific Coast to engage almost entirely in this traffic.

Recognizing the commercial value of the sailing vessel in the lumber-carrying trade, the Forest Line, controlled by the Grays Harbor Motorship Corporation, Aberdeen, Wash., has recently added to its fleet several of what are considered the last word in wind-jammer freighters.

The vessels were designed by M. R. Ward, the vice-president and general manager of the corporation, who during the war produced what was known as the "Ward Type" ship, one of the most efficient of the wooden vessel types adopted by the Emergency Fleet Corporation. The design is the result of a careful balancing of the various requirements of a lumber-carrying vessel which have been found by experience necessary in this trade.

GENERAL DETAILS OF CONSTRUCTION

Among other notable deviations from general practice in construction, the design incorporates a series of steel reinforcing frames at the turn of the bilge. These reinforcements, consisting of ¾-inch by 14-inch steel plates averaging 13 feet in length, are placed on every third frame for about three-fourths of the vessel's length. For final installation the plates are bent to the proper curvature and bolted through the wooden frames. To further strengthen the members, 6-inch by 6-inch by ½-inch angle irons are riveted to the steel plate, and after the vessel is ceiled a ½-inch strap is bolted through the ceiling to the angle irons by means of two bolts in each strake.

The Ward design also includes an arch keelson built up to the height of the 'tween decks. Both the above features contribute materially in reducing the weight of the other members entering into the construction of the hull, thus increasing both the bulk and deadweight carrying capacity of the vessels.

MACHINERY INSTALLED

There is one winch in the donkey house forward of hatch No. 1, mounted on the same frame with a specially constructed Lloyd's tested 54-inch donkey boiler. There is also one winch forward of hatch No. 2. With this handling gear very fast time for a sailing vessel can be attained in handling lumber; in fact, in loading the *Forest Pride*, a vessel of the type described above, it was demonstrated that under reasonably favorable conditions as much as 200,000 board feet of lumber could be loaded in eight hours.

Mounted athwart the top of the donkey house, at the after end, is a 3 15/16-inch shaft carrying two gypsy heads, which can be driven either from the winch in the donkey house or from a 12-horsepower standard distillate engine, through a specially constructed reduction gear. The gear ratio between the engine shaft and the gypsy shaft is eight to one, giving a speed of about 40 revolutions per minute on the heads when the engine is turning at its rated speed. This results in a purchase at the gypsy heads that makes possible the handling of the heaviest loads, even to weighing the anchors. In utilizing the heads for this purpose in an emergency it is necessary to connect them to the windlass by means of a messenger chain. The distillate engine is also used to drive a Liverpool pump installed just aft of the engine house, connection also being made through a messenger chain.

An ample water supply is provided in the form of two 3,000-gallon tanks placed on the 'tween decks, just aft of the chain locker, and immediately aft of these is located a 6-inch by 4-inch by 6-inch duplex general service steam pump, which may be used for pumping bilge or for fire protection. This pump is reached from a hatch located in the sailors' quarters in the forecastle. Between hatches 2 and 3 two hand deck pumps with cylinders 7 inches by 5 inches are installed as low as possible. There is also one portable hand deck pump provided with the necessary

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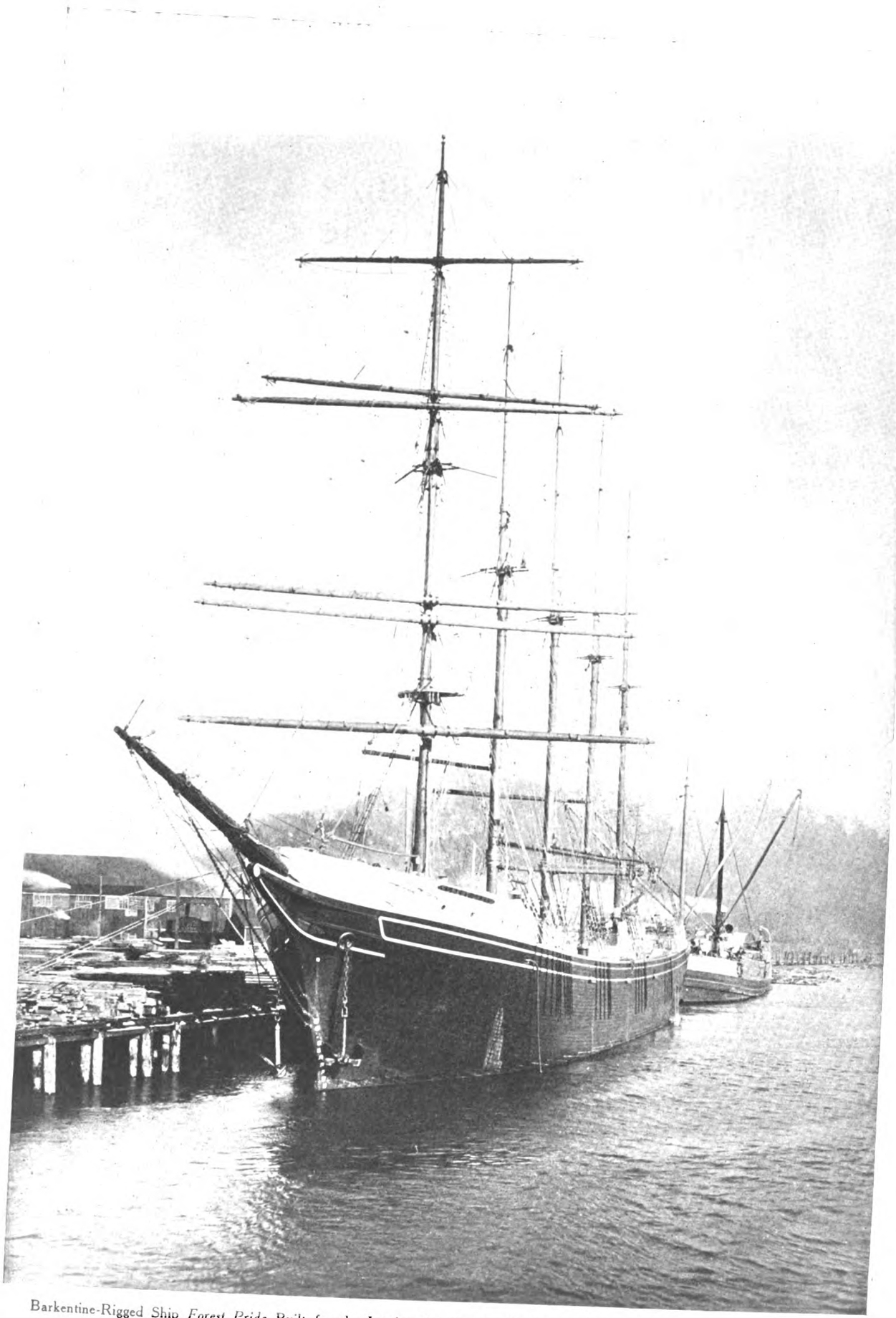

Barkentine-Rigged Ship *Forest Pride* Built for the Lumber-Carrying Trade Between Pacific Coast Ports and the Far East

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the oil direct onto the engaging teeth, thereby providing a film ot oil between the surfaces in contact. All other bearings in connection with the turbines and gearing also work under a system of forced lubrication.

The Michel type of thrust bearing is used both in connection with the adjusting of the high and low pressure turbines and the main thrust block.

The condensing plant is made capable of maintaining a vacuum of 28½ inches, with the temperature of sea water at 60 degrees F. when the machinery is developing its full service power. A very complete installation of auxiliary machinery is provided to cope with the whole of the engine room and deck requirements of a vessel of this class. This includes an auxiliary condenser of suitable size.

BOILERS

The boilers are of the multitubular type, single ended and three in number. They are arranged for working with Howden's system of forced draft. The working pressure of the boilers is 220 pounds per square inch. An approved type of superheater is fitted in connection with the boilers, and the temperature of the superheated steam entering the turbines is about 200 degrees F. in excess of saturated steam. Special attention has been paid to the provision of suitable materials which come in contact with the superheated steam, both in the boiler and engine rooms, and considerable attention has been given to the insulating of all hot surfaces, by the provision and application of special non-conducting materials. A fan arranged for driving by two engines, one being a stand-by, is fitted for supplying the air for the forced draft. The stack is of oval section with outer casing, which is carried the full height.

Ample and well directed ventilation is provided for both the engine and boiler rooms. The machinery throughout has been built to the Norwegian Veritas classification for a passenger vessel, and it also complies with the requirements of the London convention. The new vessel will be a great acquisition to the owners' fleet, and will without doubt rapidly become popular with the traveling public.

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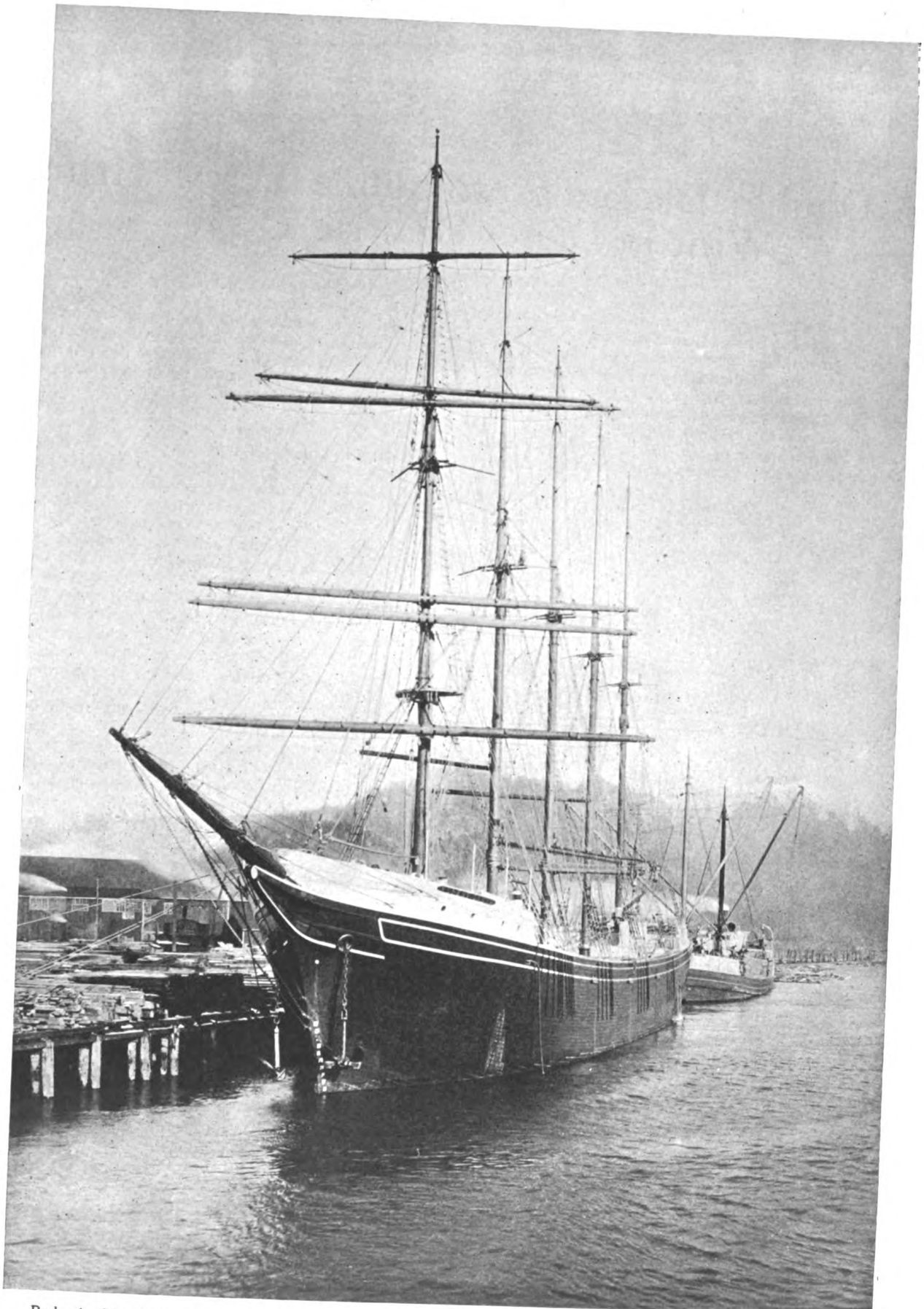

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suction and discharge hose. A Fairbanks-Morse electric lighting plant, placed aft, where it can be given continual attention, provides ample lighting capacity.

The behavior of the *Forest Pride*, which recently left for Australia with a lumber cargo exceeding 1,665,000 board feet, indicates that these vessels will need but little ballast to carry heavy cargoes of lumber and none whatever to trim them fore and aft.

A Double Decked Automobile Ferry with a Winton Diesel Electric Drive

BY RENWICK Z. DICKIE*

THE problem of automobile transportation over water is becoming acute and much interest is manifested in the design of vessels for the carriage of motor vehicles. Up to the present time no radical departure had been made in the design of these vessels or their power plant, as in most cases boats that were formerly used for other services have been converted into automobile ferries.

From the standpoint of the hull, a vessel of certain fixed dimensions could have its capacity increased nearly

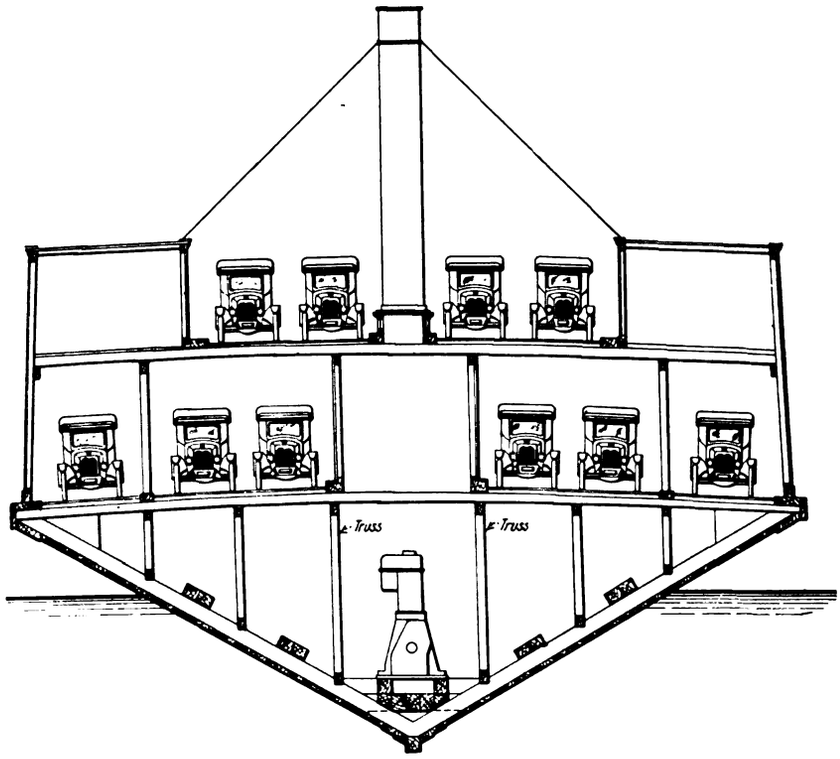

Fig. 1.—Midship Section

100 percent by the addition of another deck designed to carry machines, and for the sake of safety it would be well to carry the machines in the middle of this upper deck with the cabins on the side, so that it would be impossible for any driver to make a mistake and drive off the boat.

Cost

This would mean specially designed slips with double aprons, which could be arranged to work simultaneously. The main deck should be made to fit the slips which are now in use, so that the boat could be used temporarily in another route if necessary. To double the capacity of the boat in this way would involve a 20 percent increase in the cost of hull, decks and houses, while the increase in cost of the slips would be about 50 percent. Many projects which are contemplated in the present day founder on their first cost due to the high cost of material and labor. In starting a new project the ideas o fthe principals are so expensive that it is impossible to carry them out and make a paying proposition.

Type of Ferry

In MARINE ENGINEERING, December, 1913, a steel ferry boat called the *South Jacksonville* is shown using a V-bottom of the simplest type of construction. This boat was designed and built by Merrill-Stevens Company, Jacksonville, Fla., for the Jacksonville Ferry and Land Company, and is the result of the experience with a wooden steam ferry called the *Duval*, designed and built by the same builders some time ago, which has proven highly successful in service. It is our intention to use this simple model, thereby reducing the weight and the cost of the hull, this type lending itself very readily to ferry boat design, as a normal ferry boat hull has a block coefficient of 0.4 and the displacement and stability increase very rapidly as the boat is loaded.

Description

The sketches show a double deck automobile ferry 205 feet long overall, 191 feet long between perpendiculars, and 44 feet beam, with a breadth over the guards of 68½ feet. Accommodations for the crew, not shown in sketch plans, will be arranged in the under deck space adjoining the engines. The upper deck is shown open on plans, but it can be easily roofed over if found advisable.

Propelling Machinery

It is proposed to install a double end screw electric drive as made by the Winton Engine Company, Cleveland, Ohio, in collaboration with the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., and the plant will consist of two 500-horsepower, 8-cylinder engines. Each one is directly connected to a generator, which in turn drives a motor connected to a propeller at each end, turning at 135 revolutions per minute.

Each driving motor will be operated independently of the other, and this will give an opportunity of getting data as to the gain, if any, of operating these propellers at different speeds, as it is generally believed that a screw

* D. W. & R. Z. Dickie, engineers and naval architects, San Francisco, Cal.

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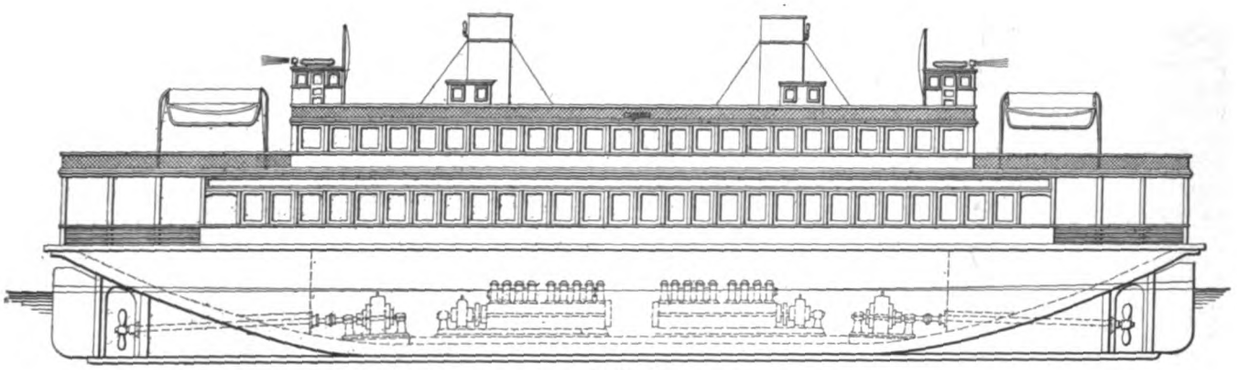
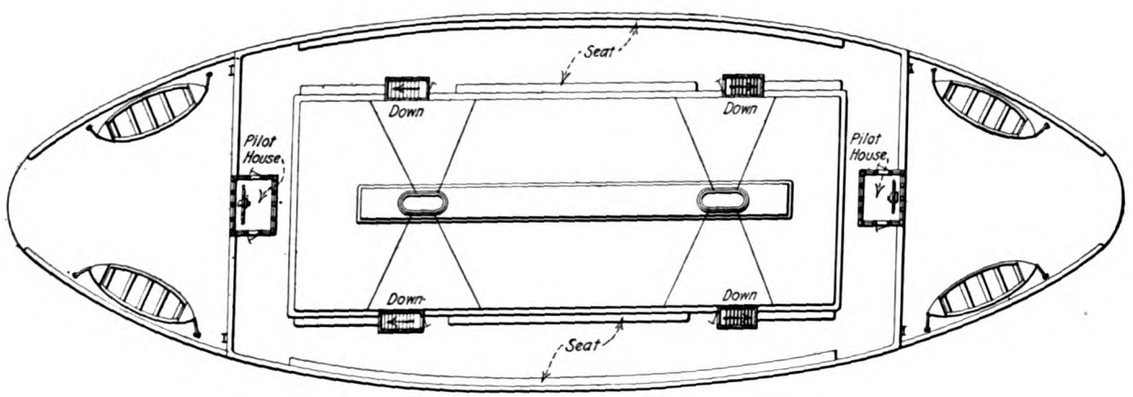
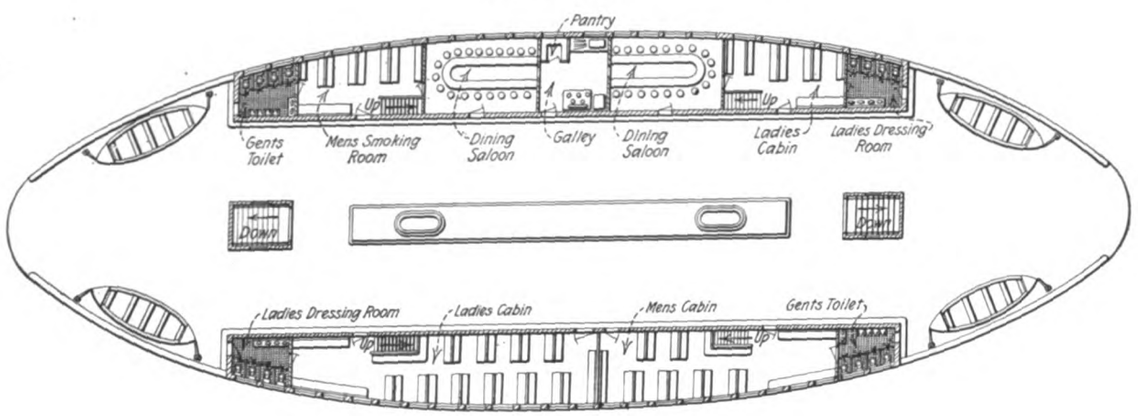


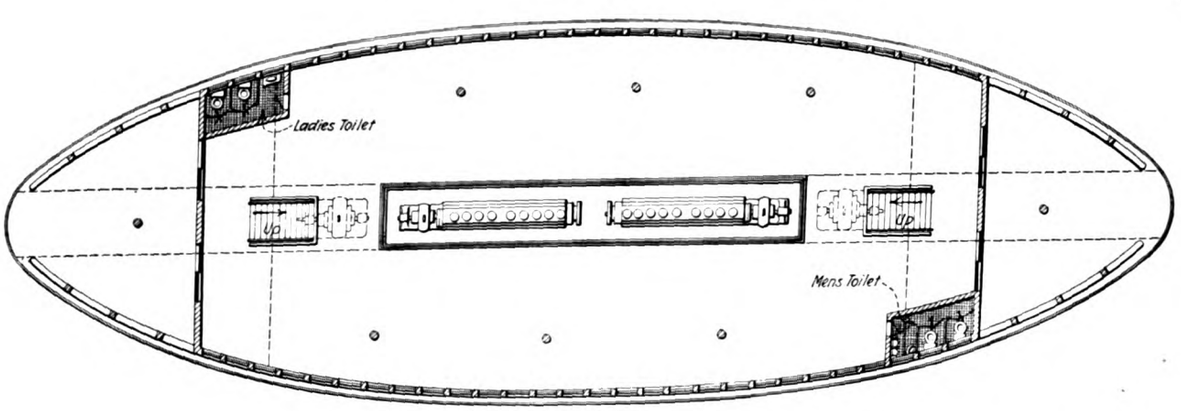
PROFILE



PROMENADE DECK



UPPER DECK



MAIN DECK

Fig. 2.—Profile and Deck Plans of Double Deck Automobile Ferry. Length Overall, 205 Feet; Length Between Perpendiculars, 191 Feet; Beam, 44 Feet; Beam Over Guards, 68 Feet 6 Inches; Horsepower, 1,000

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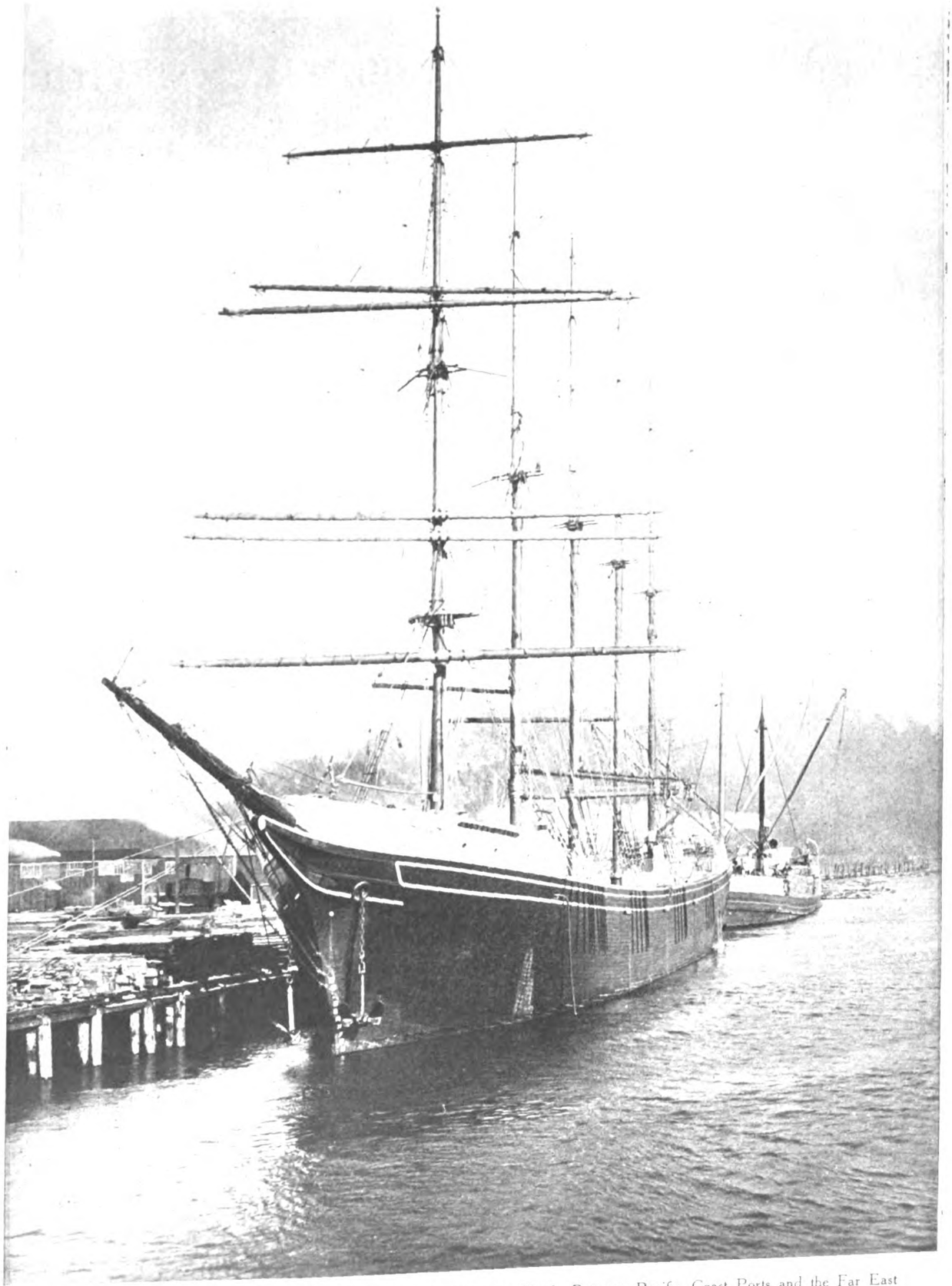

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ferry boat would give higher propulsive efficiency if the propeller at the stern were driven faster due to its working partly in the wake of the forward propeller. The driving motors will be designed large enough to take an overload of at least 50 percent when starting and stopping, and the control of the field current will be arranged so it can be reversed, and, if deemed advisable, this control can be at the hand of the navigator in the pilot house.

AUXILIARIES

All the auxiliaries, such as steering gear, sanitary, fire and bilge pumps, can be handled from the main power plant, as they will all be motor driven. An auxiliary generating set of 30 kilowatts capacity will be fitted to take care of the lighting and pumps while the vessel is in the slip.

In comparing this electric installation with propulsion by a steam beam engine, it is assumed that two electricians can properly care for the plant and that their wages would just offset the wages of the firemen in the steam plant.

COMPARISON WITH BEAM ENGINE

For the sake of comparison, it is assumed that the boat will be in operation for sixteen hours a day and will be in the slip about eight hours.

	Diesel Electric Drive	Beam Engine Jet Condensing Plant
Indicated horsepower	1,000	1,000
Weight of plant installed, tons	200	250
Fuel used per hour per horsepower	.45	2.
Fuel used per hour, barrels	1.7	4.7
Fuel used in barrels per day running 16 hours	27.2	75.2
Fuel used per hour in slip, barrels	.25	.25
Lubricating oil used per day, 16 hours running, gallons	18	6
Lubricating oil used per hour in slip, gallons	.75	.25
Hours running	16	16
Hours in slip	8	8
Cost of lubricating oil per gallon, cents	.29	.43
Cost of lubricating oil per year	$2,540.40	$1,255.60
Cost of fuel oil per barrel	$1.85	$1.60
Cost of fuel oil per day running	$30.32	$120.32
Cost of fuel oil per day in slip	$3.70	$3.20
Water used per day for power plant, tons		25
Weight of water carried in tons for power plant		50
Cost of water, at 10 cents per ton, per day		$5.00
Fuel used per year, in barrels	10,658	28,178
Water used per year for power plant, tons	00	912
Cost of water per year		$912.00
Total cost of fuel, water and lubricating oil for 1 year	$22,240.00	$47,267.60

It will be seen that there will be a saving of about $2,000 a month in the cost of operation of the power plant through the saving in fuel, water and lubricating oil, and besides this the boat can handle nearly twice as many machines as a single decked automobile ferry.

Ships, Past and Future*

BY FRANK E. KIRBY, CONSULTING ENGINEER

IN early days the ports along the New England coast were largely interested in deep-sea shipping. In fact, it was the most profitable business of Portsmouth, Newburyport, Gloucester, Salem, Boston, New Bedford and other smaller ports. The ships flying the American flag traded in all the ports of the world. About the only evidence of their former activities to be seen now is in the museums in those towns, where there are models and pictures of ships, nautical instruments and other interesting articles pertaining to the ship business.

The shipping business prospered in those ports up to the beginning of the Civil War, reaching its highest efficiency during the clipper ship era in the fifties, following the discovery of gold in California. During that period the United States led the world in the character of its merchant ships, but a great change was coming. The introduction of steam power in ships, which was rapidly developed in Great Britain, after first being tried by America, provided more certain, rapid and economical transportation, though for many years the sailing ships held their own, particularly for long voyages, due to the use of the paddle wheel propeller. The introduction of the screw propeller, particularly in iron and steel ships, finally ended practically the domination of the sailing ship. Excepting Boston, the New England ports took no part in the development of steam ships. New York became the principal port for steamers. American lines were established to Great Britain, France and Germany. The ships were propelled by paddle wheels and, like our sailing ships, were the best in the world.

Through the failure of America, and particularly of New York, to appreciate the screw propeller, notwithstanding it was introduced into this country by Captain Ericson contemporarily with its introduction into Great Britain, our ships were finally driven from the seas. A last chance was attempted by Boston about 1860, I think. They built two screw steamers for the Liverpool service, the *Merrimac* and *Mississippi*. I am not sure either one of them ever made a voyage to Liverpool; however, they were utilized by the Government during the Civil War for transports and did good service.

After the war I think one of them ran to Bremen for a while and afterwards to Panama. They were built of iron and were fairly up to date at the time of their construction, though they proved weak in some particulars.

The next attempt with screw-propelled ships was more successful. The American liners *Pennsylvania, Illinois, Ohio* and *Indiana* were built by Crane at Philadelphia about 1871 or 1872 for service between that port and Liverpool. They had iron hulls and compound engines. They continued in service for nearly twenty years and were followed by the well-known ships *St. Louis* and *St. Paul* and some others for service to Antwerp. The results of their operations can be judged by the fact that the company has not built any new ships for many years.

I want particularly to emphasize the fact that America did not appreciate the importance of the screw propeller as a factor in the development of sea-going ships, and later we were slow to appreciate the value of the compound engine, although early adopted in this country. We have taken more kindly to the turbine, due principally to necessity on account of the late war. And now, are we awake to the value of the "Diesel" motor or the possibility of the "Still" motor?

To recapitulate, the screw propeller, the compound engine, the Diesel or Still motors mean economy. It should be spelled with capital letters, without which we cannot compete, no more than any manufacturer with obsolete tools; not only must we use economical tools, but we must produce them economically. In short, we must build ships at less cost than any other people if we are to lead. It is a fact that this country has the greatest natural advanages in the supply of raw materials that enter into the construction of ships, and some explanation and apology is due if we can't build ships at less cost than any other people. Some say it is the high cost of living that prevents us from building ships at low cost, and that calls for another explanation, and why, when we have the greatest natural resources for supply of food, and all other necessities of living, it costs more to live in the United States than anywhere else in the world. We would not like to admit that it is because we don't know how to build ships or how to live. But why can't we do it? We can, but will we? That is the question.

* From *Speed Up*, published by the Submarine Boat Corporation, Newark Bay, N. J.

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Some Pertinent Remarks

BY "OLD SCOTCH"

WELL, we are on the map at last! The Merchant Marine Act, 1920, which was approved June 5th last, may well be named the "Maritime Declaration of Independence" for the United States. The preamble of our sacred national bill of rights might well be paraphrased something like the following:

"When, in the course of human events, it becomes necessary for one people to disolve the *shipping dependency* which has bound them with another, and to assume among the *maritime nations* of the earth the separate and equal *rights on the seas* to which the laws of Nature and of Nature's God entitles them....."

Senator Jones and Congressman Greene might well be called the Thomas Jeffersons of the period, so far as this maritime declaration is concerned.

An American Act Through and Through

The act is American through and through, and if we cannot make good with such liberal legislation on the statute books we may as well give up further attempts and admit that it is our own fault that we do not keep the ships going. This law stops short only of a direct subsidy, but later, if it is found necessary to resort to that method of running our ships, the now anounced policy of the Government will admit of even that extreme. Let us all pull together and hope that we can get along without it!

Although the measure passed the House originally with but few votes in opposition and was put through the Senate without even the formality of a roll call, when it got in conference real opposition began to develop. Under very thinly disguised subterfuges representatives of foreign interests began insidious attacks, which, but for splendid generalship on the part of the managers of the bill, might have resulted in the defeat of the measure, or at least a serious crippling of its important features.*

Such opposition no doubt originated among our rivals to protect their own interests as they see them. However, our viewpoint is decidedly different, and we have only been demanding what we know to be our rights. To show how our efforts are considered on the other side, we can quote the following extract from a speech made by a member of Parliament, when he said:

As Others See Us

"At all costs our maritime supremacy must be maintained. American shipping has been due to emergency methods carried on regardless of expense, placed in the hands of people lacking knowledge or experience of shipping management, and based on a system of costs so high as to make economical operation an impossibility."

Perhaps in light of the above it is due to the affection which our English cousins bear for us that they do not want to see us lose our money in shipping. However, I do not think that such solicitude will deter many of us from doing "our darndest" to make things go. Just the same we might all take heed of what this worthy member says about running ships "regardless of expense." Heretofore that statement has been only too true, and, as I pointed out in the June number, it is time we took heed of this recklessness and put on the economy brakes.

Among the most beneficial clauses of the new legislative act are:

Beneficial Clauses of the Shipping Act

The first step towards providing discriminatory duties on goods imported in the United States, to favor American vessels. It appears that under the Underwood tariff act there is already a law on the statute books whereby goods imported in American vessels will have the benefit of 5 percent less duties. All that is needed is the repeal of certain treaties which is now authorized.

The arrangement of a satisfactory system governing mortgages to encourage citizens to invest their earnings in ship securities.

Exempting marine insurance companies from prosecution under the anti-trust law if they form pools or syndicates to control the business in this country.

The limitation of the coastwise trade to American built and owned vessels, with certain modifications for foreign built vessels now in control of American interests, and the extension of these laws to our insular possessions.

The authorization for the Shipping Board to extend financial help to the builders of new vessels of desirable types, to the extent of $25,000,000 annually for a period of five years. The Senate intended this to be $50,000,000 annually, but in conference it was cut in half.

The permission to fix lower railroad rates for goods imported or exported in American vessels. This clause may be made of the greatest help when competition for the world's trade becomes as keen as it was in pre-war days.

Sale of Government-Owned Ships

The requirements under which the ships now belonging to the Government may be disposed of are not such as meet the hearty approval of the shipbuilders, but with good judgment on the part of the new Shipping Board the selling of the ships may be made under such terms that will not necessarily preclude the placing of new orders in the shipyards, as has been feared by the builders.

So much depends upon the ability and integrity of the new board for the proper enforcement of the entire act that we are all hoping that none but capable and broad-minded men will be appointed. Some good upstanding "tight wads" are needed on the board about as much as any other pre-requisite. When we get members of this board who will be as careful in spending government money as they are in doling out their own, we need have but few fears of the ultimate success of our shipping ventures.

A Shipping Board Commissioner from the Interior

Such a qualification might have been put in the law as many other qualifications were specified, including a limitation as to how many of any political faith could be named. As one of the seven new members is required to be from the interior and to have a knowledge of shipping, some remarks were made to the effect that such a man would be an anomaly. However, there is a shining example of the right kind of a man to fill these requirements in the person of Secretary Alexander of the Department of Commerce. Being from Missouri and adopting the state policy of "show me," probably accounts for the splendid mental equipment this gentleman has for a posi-

* According to late reports which have leaked out, pressure was even brought at the White House to have the President veto the bill, but as Mr. Wilson has consistently favored the upbuilding of the American merchant marine, both before and during his incumbency of the Presidency, his approval was given to the measure, despite all opposition.

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tion on the Shipping Board. Everyone I know of hopes that in some manner or other arrangements may be made whereby he can go on the Board.

EXEMPT AMERICAN VESSELS FROM PANAMA CANAL TOLLS

Senator Borah had the right idea when he introduced a bill in the Senate at the close of the session to exempt American vessels from Panama Canal tolls. This is one of the objects for which this great waterway was built, and the underlying reasons why our vessels were deprived of this benefit are now so well understood that the sooner such restrictions are removed the better it will be for the future of the American merchant marine. Let us hope the bill will have favorable action by Congress at its next session.

Another job awaiting Congress for the benefit of the merchant marine is the revision of our navigation laws. The committee of experts appointed by the Shipping Board has made its report on needed changes, and it is now understood that the laws are being re-codified by a committee of legal experts, also appointed by the Shipping Board. The so-called Franklin committee has, so we are advised, definitely determined that there is no discrepancy in the measurements for net tonnage on American built and owned vessels as compared with similar measurments on foreign vessels. This is one important controversial point settled at any event.

THE SHIPBUILDING OUTLOOK

Things do not look so roseate to our shipbuilders just now, which must, of course, be expected. Our present facilities in this country are more than sufficient to build all the tonnage for the entire world, which, naturally, we cannot expect to get. There are, therefore, many new yards throughout the country which must soon go out of business. Hog Island, the largest of them all, is booked to close down in the early autumn, and many others will soon follow.

It is difficult for us to realize how rapidly existing shipbuilding orders are being completed. In Shipping Board vessels alone over 850,000 gross tons of ships were delivered this year up to May 1. At this time the tonnage building for private account—that is, of ships ordered since the armistice—exceeds that of ships building for the Shipping Board. At the present rate of progress there will not be more than perhaps 250,000 tons of government owned merchant ships under construction by January 1 next.

There has been a woeful lack of new orders for private account during the past two months; this, however, may be attributed to two causes, rather than to lack of demand. Money conditions form the primary cause, while the other is undoubtedly the uncertainties which always inflict business interests during a presidential year. With the election of a President who will be deemed safe and sound by the financial interests, and with the disposal of certain undesirable tonnage abroad by the Shipping Board, it is only reasonable to expect that the years 1921 and 1922 will witness busy times in such of the American shipyards as have been able to withstand the slackening up period which we are now going through and which was inevitable from economic conditions.

SHIP REPAIRING STEADILY INCREASING

While new building is decreasing, the amount of ship repairing is steadily increasing on account of the number of new ships placed in operation. This will provide work for many of the shipbuilding plants which have foreseen this condition of affairs and have added to their ship repair facilities. The Martin-Gardiner syndicate, which is to furnish the surveying and engineering talent for supervising all repairs to Shipping Board vessels, either owned or controlled by the Government, which amount to over $10,000 on any particular ship, is nearly ready to commence operations, with its main office at 23 Liberty street, New York. The object of this syndicate is to promote uniformity and economy in all ship repairs, and from the high standing of the gentlemen to whom this task is entrusted there seems little doubt but that the Board has acted wisely in making this arrangement. This syndicate will also supervise the authorization of all kinds of supplies and stores for the operation of the vessels.

NAVAL CONSTRUCTION

In looking over the shipbuilding field it must not be forgotten that despite the fact that Congress has failed to make authorization for many new vessels for the Navy during the past two years there are still about 175 new warships of all classes, ranging from sea-going tugs to first-class battleships, and costing hundreds of millions of dollars, under various stages of construction. As some of them are not scheduled for completion for over two years, the Navy work will continue to be an important factor in shipbuilding for some time to come. It is regrettable that Congress failed to authorize the construction of the seven type *B* Hog Island ships for aviation purposes, which were recommended by the Navy Department and passed by the Senate.

Conversion of "Kil" Class Gunboats Into Cargo Steamers

EIGHT British patrol gunboats of the *Kil* class, each 170 feet long between perpendiculars, 20 feet 10 inches beam, and 16 feet 6 inches molded depth, are being converted by J. Samuel White & Company, Ltd., East Cowes, Isle of Wight, into coastal cargo boats. These vessels are the *Kilmelford, Kilmarten, Kilmuckridge, Kildavin, Kilmead, Kilmallock, Kilmore* and *Kildorry*, the majority of which were built by Smith's Dock Company, Middlesborough.

The conversion is being carried out in compliance with British Corporation rules, Class B.S.*, and the work in each case includes the straightening of the stem, as the boats are double enders, and the building of a forecastle. All of the vessels are equipped with two boilers. The forward one in each case is being removed and the space fitted out as a cargo hold. The existing triple expansion engine will remain in its original position and will give a speed of about 10 knots.

As rebuilt, the vessels will have a deadweight capacity, including bunkers, of 650 tons. The forward cargo hold, which is served by a hatch 38 feet by 19 feet, will have a capacity of 23,000 cubic feet, and the aft hold, served by a hatch 22 feet by 11 feet, will have a capacity of 5,900 cubic feet. The coal bunker capacity will be 80 tons.

Two steel masts are to be fitted to each vessel and a 3-ton wood derrick will be fitted on each mast: a cargo winch 6 inches by 10 inches will be fitted at each hatch.

Provision will be made for the accommodation of 19 officers and men in each vessel. The crew will be berthed under the forecastle. The side plating amidships will be extended to enclose the bridge space, where accommodations will be provided for the officers on the main deck and for the chart and wheel house on the bridge deck.

From start to finish the work of conversion will require about two months for each ship.

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New Matson Freighters to Be Fitted with Geared Turbines

THE two new freighters being built for the Matson Navigation Company at the yards of the Moore Shipbuilding Company will be 497 feet long overall, have a molded beam of 62 feet and a deadweight capacity of 14,000 tons at a draft of 30 feet. They are specially designed for the rapid and economical handling of cargoes, the machinery being placed aft and the holds arranged with minimum obstructions and a maximum of hatches and ports.

The propelling equipment of each ship will consist of a 5,000 shaft horsepower Westinghouse turbine, consisting of a high pressure and a low pressure element which will drive the propeller through a common floating frame gear. This gear is to be of the double reduction type, reducing the turbine speed of 3,500 revolutions per minute to 95 revolutions per minute—a ratio of about 37 to 1. The speed of the ship will be 12½ knots.

Main Turbines

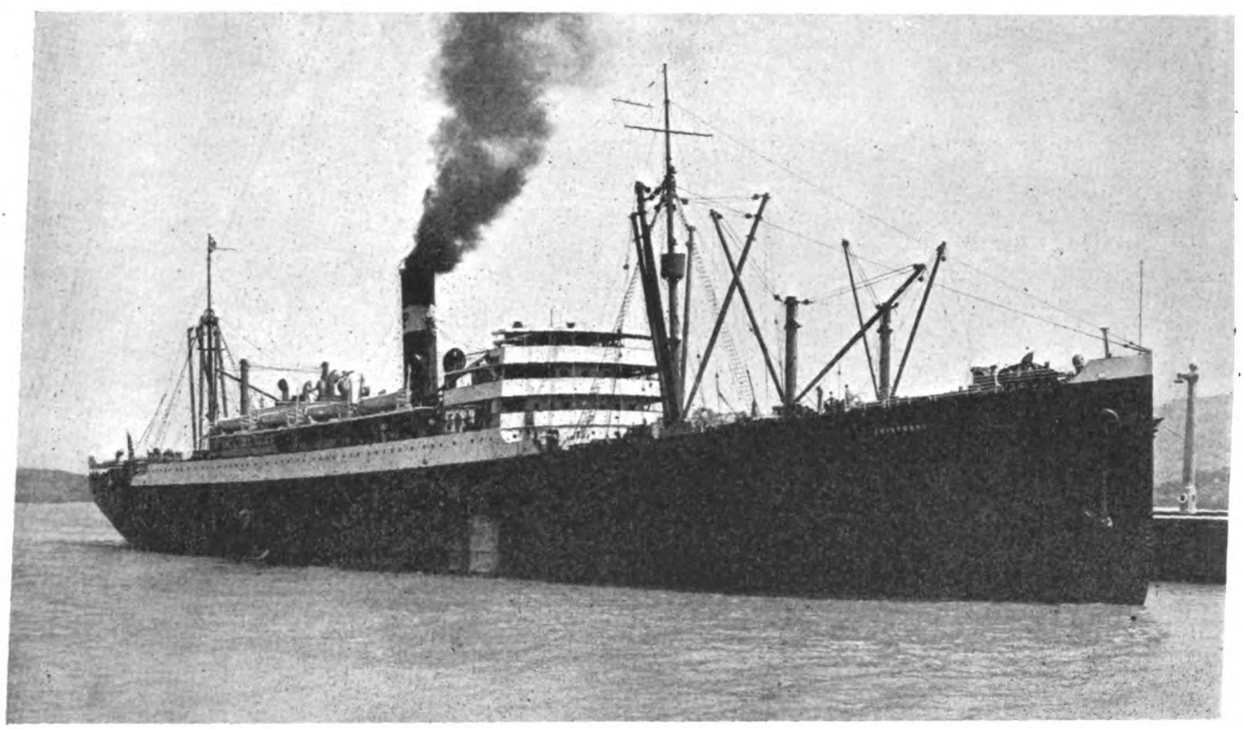
Each turbine element can be operated separately, if the other is out of commission, and both contain astern elements giving 40 percent of ahead power. Additional nozzles are provided on each turbine to permit of an increase of 20 percent of the turbine's power in case either steam pressure or vacuum (or both) should fall below normal.

The boilers will be oil fired and will carry a steam pressure of 225 pounds. The superheat will be 50 degrees and the vacuum 28½ inches.

In addition to the turbines and gears for these vessels, the Westinghouse Company will also furnish the air ejectors, air separators, condensate pumps and other auxiliaries. The condensers in each ship will have a total cooling surface of 10,500 square feet, designed to maintain the required vacuum for most efficient operation.

Steamship Cristobal Rebuilt at Panama Canal Shops

THE steamship *Cristobal* of the Panama Railroad Steamship Line has been rebuilt by the Mechanical Division of The Panama Canal. The vessel was sent to the Balboa shops in May, 1919, for general reconstruction. Every part that was worn was replaced, from hull plates to the railing around the deck. The system of coal-burning boilers was changed to oil burners, with a general reconstruction of the burner and boiler spaces. New boilers were installed, and all worn parts of the engines, main and auxiliary, replaced with new. The capacity for cold storage was increased to over 13,000 cubic feet. The passenger accommodations were renovated and increased so that she can now accommodate approximately 150 first class passengers.



S. S. *Cristobal*, Rebuilt in Panama Canal Shops, Leaving Pedro Miguel Lock on Way Through Canal to the Atlantic

Public Rooms Finished in New Wood

A new smoking room, social hall and dining room were built and finished throughout in *caoba blanca*, or the light mahogany of Panama. This is a kind of wood never used prior to 1917 and unknown commercially outside of the local uses on the Isthmus and in the shops of the Canal. It possesses an unusual beauty in grain and color and offers an excellent surface for the most artistic finish in cabinet work. Practically all of the ship above the main deck is entirely new.

The *Cristobal* is a ship of 9,332 gross tons, 489 feet 6 inches in length by 58 feet beam, and 28 feet 10 inches depth. She was built in 1902 at Sparrows Point, Md., and purchased in 1909 by the Panama Railroad Steamship Line for $850,000. Today her value is estimated at around $3,000,000.

After the completion of the installation of furnishings in New York, the *Cristobal* will go back on the run of the Panama Railroad Steamship Line between New York and the Canal Zone.

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Prominent Members of American Steamship Owners Association

(1) H. H. Raymond, President, Clyde and Mallory Lines; President, American Steamship Owners' Association. (2) Edward J. Barber, President, Barber Steamship Lines, Inc.; Vice-President, American Steamship Owners' Association. (3) Winthrop L. Marvin, Vice-President and General Manager, American Steamship Owners' Association. (4) Alfred Gilbert Smith, President, New York & Cuba Mail Steamship Company; Chairman, Committee on Depreciation, American Steamship Owners' Association. (5) P. A. S. Franklin, President, The International Mercantile Marine Company; Member, Executive Committee, American Steamship Owners' Association. (6) Captain Eugene E. O'Donnell, Manager, Marine Department, C. H. Sprague & Son, Boston; Chairman, Committee on Wages and Working Conditions Aboard Ship, American Steamship Owners' Association. (7) Franklin D. Mooney, President, New York & Porto Rico Steamship Company; Member, Committee on Managing Agency Agreement, American Steamship Owners' Association (Photograph Copyright by Underwood & Underwood Studios, N. Y.). (8) Oakley Wood, Vice-President, Barber Steamship Lines, Inc.; Acting Chairman, Committee on Managing Agency Agreement, American Steamship Owners' Association

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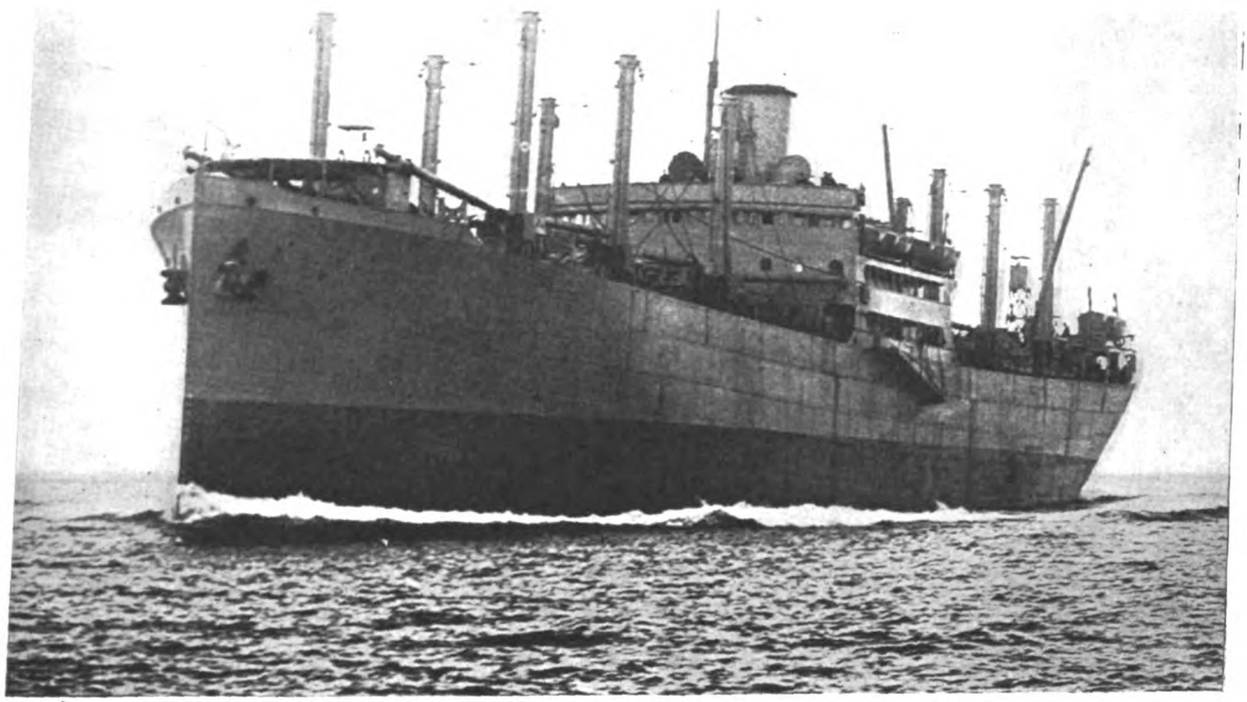

An American Cargo Carrier of Today. One of the Many Fine Steel Ships of the Modern Merchant Marine. This Vessel Has a Cargo Capacity of 14,000 Tons. She Was Built During the Progress of the Great War

Team Work for the Merchant Marine

"Each for all and all for each" would be an appropriate motto for American shipowners today. Team work is the keynote of their efforts to maintain as a growing and profitable institution the great merchant marine fleet which was created as a result of the war and is being developed and balanced to meet the demands of peaceful world trade. Interchange of ideas, mutual effort for the common good and a closely knit alliance of the various units of the shipping business in matters of policy affecting its general welfare, with means of an interchange of ideas and information with allied interests of national scope, form the basis of new business methods in the American shipping world.

IN the early days of American shipping, now chiefly recalled for the triumphs of our clipper ships, no owner conferred with his competitor on the development of trade routes or the study of economic problems in the shipping business. It was a period of every man for himself among American shipowners, and secrecy was the main stay of each individual's ventures. This was carried so far at one period at the old port of Salem that ships were fitted out by stealth and sailed at night. One Salem ship made three voyages to Sumatra for pepper and earned a fortune for her owner before competitors could discover the source of her cargoes.

Co-operation Necessary

Today such a system is impracticable, nor is it to be desired. The trade map of the world lies before every shipowner, with its every sea route designated. The route on which a ship sails usually is announced in advance. Her freight rate is fixed in competition with other ships of her own and other flags. A ship no longer sails into silence and mystery when she leaves port. She is in daily touch with other ships or the shore by means of the radio. Her consignee or agent in a distant country is advised by cable of her departure and by radio of her progress and expected hour of arrival at her destination, and yet the shipping business is vastly more complex than in the good old days of the sail, when every owner was for himself. Costs are extraordinarily high. Rates in all cases are not adequate to meet those costs, as, for example, in the coastwise trade. The relations of the ship operator and the men employed on his ships are subject to negotiation and agreements into which numerous troublesome ele-

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ments enter that were not present in earlier times. Insurance is a complicated and difficult branch of the shipping business; navigation laws, long in need of revision, in many instances are a burden on the shipowner; vast amounts of capital are invested in ships, and to earn adequate returns for these great sums, even with business active, the shipowner must be always on the alert and must know the ebb and flow of trade in all parts of the world.

A community of interests among shipping men therefore is logical and inevitable. By such means the shipping men of the country avail themselves of their combined strength and resources in solving the many problems, economic in the main, that arise in a business so vast as theirs and so newly grown to its present proportions. The country invested between three billion and four billion dollars in ships between 1917 and 1920. This great investment is now subject to the test of competition with the mercantile services of other countries. The task of making the investment permanent rests upon the shoulders of the American shipowners.

American Steamship Owners' Association

Fortunately for the American merchant marine, the shipowners of the country when the war began were not without an organization of a national character, equipped to take the lead in concerted action by shipping interests in behalf of the new-fledged fleet and for the protection of the great investment it represented. This was the American Steamship Association, a body including in its membership the leading companies owning and operating steamships under the American flag. Organized in 1906 by a number of coastwise steamship companies, the association had grown so steadily that in 1917, when the United States entered the world war and embarked upon the great shipbuilding programme that resulted in its present merchant fleet (which by the end of 1921 will embrace 18,000,000 deadweight tons of ocean-going ships), the American Steamship Association included in its membership the principal companies engaged in overseas trade under the American flag. As new companies were formed in the era of rapid shipping expansion that now set in, many obtained membership in the association, which in September, 1919, found an expansion of its organization necessary to carry on its varied and rapidly growing activities. At that time the word "owners" was added to the association's title, and the executive committee, the governing board, was enlarged to twenty-five to make it more thoroughly representative of the increased membership of the association. Mr. H. H. Raymond, president of the Clyde and Mallory Lines, at once a leading figure in the coastwise trade and conspicuous in overseas carrying, who had served as the president of the association for several years, was unanimously re-elected to the presidency. Mr. Edward J. Barber, head of the important Barber Steamship Lines, Inc., operating to the River Plate, the Orient and transatlantic ports, was re-elected vice-president, while Mr. Winthrop L. Marvin was elected to the new office of vice-president and general manager. Mr. Marvin brought to the office a profound knowledge of shipping problems and wide experience in securing coordination of effort by large business interests. At the same time the important office of general counsel of the association was assumed by J. Parker Kirlin, Esq., one of the foremost Admiralty lawyers in the United States.

President Raymond in the strengthened organization has been able to avail himself of the voluntary services of many able men in the shipping business, who, seeing the need of concerted effort by American shipowners, have consented to serve on various committees formed to deal with the vital problems of the merchant marine. Thus in a short time there has been built up an efficient and highly specialized association for dealing with the practical everyday questions of prime importance that confront shipowners and operators in their regular line of affairs.

Association Members Control Large Tonnage

By the spring of 1920 the association's members represented an ownership of not less than 3,000,000 gross tons of steamships under the American flag, or more than three times the amount of the nation's tonnage engaged in overseas trade at the beginning of the war. In addition to this tonnage, the association members operated as agents for the United States Shipping Board between 4,000,000 and 5,000,000 deadweight tons (three deadweight tons about equal two gross tons) of the war-built cargo fleet. The aggregate tonnage thus controlled by the association's members (between 6,000,000 and 7,000,000 gross) was nearly equal the nation's total tonnage, including all ships in the Great Lakes in 1914.

With the Shipping Board the nominal owner of the government-built ships, constant and often exhaustive conferences between the Board and the shipowners and operators are necessary. With legislation before Congress, involving fundamental principles of shipping policy, and therefore the future of the merchant marine as a whole, while the new fleet was not yet completed, it behooved the shipowners to present their views collectively and with unity, clearness and precision.

This has been accomplished through common counsel by the association's

Derby Wharf, Salem, Mass., the Center of American Shipping in 1820

In the First Quarter of the Last Century Salem Was the Foremost American Port for Deep Sea Trade, and in That Period More Rich Foreign Cargoes Were Landed at This Old Wharf Than Anywhere Else in the United States. From a Photograph in the Peabody Museum, Salem, Taken About Forty Years Ago

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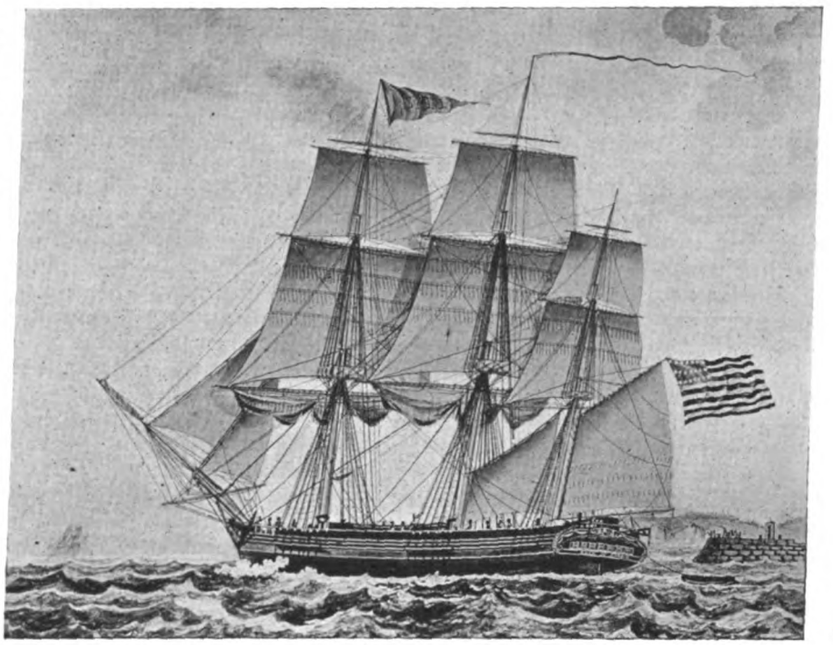
members and by sustained and intensive work by its committees. A brief summary of the functions of a few of these committees will serve to indicate the practical character of the work handled by the association.

COMMITTEE ON MANAGING AGENCY AGREEMENT

The duty of this committee is to deal with matters pertaining to the agreement with the United States Shipping Board, under which members of the association operate government-owned ships. Members of the committee attend fortnightly conferences at Washington of a joint committee composed of representatives of the Shipping Board, the shipowners of the Atlantic, Gulf and Pacific coasts, and the United States Ship Operators' Association. These conferences deal with affairs involving a greater volume of shipping traffic in one month than half a century ago stood to the credit of the entire American merchant marine in a year. Mr. Franklin D. Mooney, president of the New York and Porto Rico Steamship Company was appointed first chairman of this committee on behalf of the American Steamship Owners' Association. During Mr. Mooney's absence on a trip abroad, Mr. Oakley Wood, vice-president of the Barber Steamship Lines, Inc., served as acting chairman.



An American Cargo Carrier of a Century Ago

Vessels of This Type Laid the Foundation of Our Merchant Marine and Won Fortunes for Their Owners. This Ship, the *Erin*, Registered 270 Tons. From a Painting by Montardier, a French Artist, Made in 1819.

COMMITTEE ON WAGES AND WORKING CONDITIONS ABOARD SHIP

The negotiation annually of a working agreement with representatives of the sea-going unions on wages and working conditions (in conjunction with the United States Shipping Board) and the adjustment of all differences between the labor aboard their ships and the members of the association, are the principal duties of this committee, whose findings are the basis of present wage agreements on all American ships plying out of Atlantic and Gulf ports. Captain Eugene E. O'Donnell, manager marine department, C. H. Sprague & Son, Boston, is chairman of this committee. The names of the other members indicate the representative character of the committee:

Captain William Anderson, manager marine department, C. H. Sprague & Son, Boston, Mass.
A. G. Bates, vice-president, Atlantic & Pacific Steamship Company (W. R. Grace & Company).
Captain John G. Crowley, president, Coastwise Transportation Company.
J. D. Tomlinson, operating manager, American Hawaiian Steamship Company.
A. S. Hebble, superintending engineer, Southern Pacific Company.
E. A. Kelly, assistant to president, Clyde Steamship Company.
R. C. Thackara, vice-president, Luckenbach Steamship Company, Inc.
A. J. McCarthy, manager, American flag steamers, International Mercantile Marine Company.
F. C. Osborn, manager ownership operations department, Munson Steamship Line.
Robert F. Hand, assistant manager foreign shipping department, Standard Oil Company of New Jersey.

COMMITTEE ON DEPRECIATION

The question of the proper depreciation to be charged off annually on account of vessels owned for purposes of taxation and otherwise has been one of the most vexing to come before the members of the association. This committee sent out a questionnaire to American shipowners, seeking their views on the subject, and embodied the replies received in a report to be submitted to the association and by it to the Shipping Board and to the Treasury Department. The chairman of this committee is Mr. Alfred Gilbert Smith, president, the New York and Cuba Mail Steamship Company.

Another active committee of the association deals with the subject of the revision of the United States navigation laws and rules, including the laws and rules of the Steamboat Inspection Service, which is now being considered also by a special commission appointed by the Shipping Board. Still another committee of the association is that which deals with accounts and auditing, with especial regard to the accounts of government-owned vessels operated by the shipowners. This committee is composed of auditors of the member companies of the association.

Its own solidarity assured, the association has established close relations with other shipping associations in the country. These include the following:

United States Ship Operators' Association, New York.
Pacific American Steamship Association, San Francisco.
Puget Sound Shipowners' Association, Seattle.
New Orleans Shipowners' Association.
New York Boat Owners' Association, New York.
Lake Carriers' Association, Cleveland.
National Board of Steam Navigation, New York.

Other business associations with which the American Steamship Owners' Association is in close touch include the following:

American Manufacturers' Export Association, New York.
National Foreign Trade Council, New York.
National Association of Manufacturers, New York.
Atlantic Coast Shipbuilders' Association, New York.

Through the United States Chamber of Commerce the association is enabled to present data concerning the economic phases of the shipping business to business men in

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all sections of the country. Illustrating this connection, it may be stated that after members of the association had appeared before the Senate committee on commerce at hearings on the measure later known as the Jones bill, their arguments, printed in pamphlet form, were distributed to the chambers of commerce of the country through the co-operation of the United States Chamber of Commerce. Information on the merchant marine and overseas trade is supplied this national body of business men by the association whenever it is requested.

Touch with the banking interests of the country has been maintained by the association through an interchange of views and information with the committee on ship securities, appointed by the United States Shipping Board from among prominent bankers, with Henry M. Robinson, of Pasadena, Cal., as chairman. This committee has made a study of the relation of present shipping values, costs and earnings to popular investment in shipping securities and has submitted its first report to the Board.

Other organizations with which the association maintains relations are:

National Marine League of the United States of America, New York.
National Merchant Marine Association, Washington.
Navy League of the United States, Washington.

These three organizations disseminate information about the merchant marine through the press and by means of speakers, while the National Marine League is sponsor for the National Marine Exposition, which was held for the first time in April, 1920, at New York, and which will become an annual event in the marine calendar.

To each of the organizations named, the association sends its published communications, and in many cases special bulletins on matters regarding the merchant marine that are of current interest to business men. Furthermore, it has adopted a policy, now in effect, of supplying information of public interest on shipping matters to the daily and trade press whenever it is requested. With the growth of our merchant marine, there has developed a widespread interest in ocean trade and commerce, and the American Steamship Owners' Association has come to be accepted as, in a sense, a clearing house of information on matters maritime all over the United States.

Bulkheads

BY C. H. PEABODY, DR. ENG.

It is not commonly known that the United States has no adequate legal provision against overloading of ships whether in foreign or domestic commerce. At this time, when our merchant marine is holding a leading position in public interest, it is important that the present status of this question of safety at sea should be clearly in mind.

IN January of 1914 the International Convention on Safety of Ships at Sea made its first report. This statement is proper, even though the convention adjourned sine die, because the reports were so broadly worded that some subsequent convention was evidently needed and anticipated. The convention wisely determined only the main guiding principles, leaving the details to be worked out in the future.

The nations represented in the convention were Germany, Austria, Belgium, Denmark, Spain, United States, France, Great Britain, Italy, Norway, Holland and Russia.

The various subjects considered by the convention were navigation, construction, radio telegraphy, life-saving appliances and fire protection. The subject now selected for consideration is that of bulkheads, the proper number, their location and construction and provision of strength. Even so restricted, the subject can be treated only in a general manner.

Subsequent to the report of the convention, the British Board of Trade appointed a committee on bulkheads and watertight compartments, which reported in November, 1914. This report presents valuable constructive work in interpreting the general recommendations of the convention and in providing methods for applying them.

In September, 1916, the Honorable W. C. Redfield, then Secretary of Commerce, called a conference at Washington of shipowners, shipbuilders and naval architects, to consider establishing load lines on vessels enrolled in the United States, with which the matter of bulkheads and subdivision is intimately connected. A committee was appointed to consider and report on the establishing of load lines. That committee made a report in December of that year. In consequence of the entrance of the United States into the World War the matter of load lines passed into abeyance, but was revived in October, 1919, and is now under consideration. Subcommittees have been appointed for the Atlantic coast, for the Pacific coast and for the Great Lakes, and reports may be expected in the near future.

In this article we shall refer mainly to the report of the British committee on bulkheads; for brevity, we will call them the *committee*. Some reference will be made to the report of the British committee on vessels navigating local waters; we will call them the *local committee*.

Having in mind that steel steamers usually have the machinery amidships, we remember that they have at least four bulkheads, one forward and one aft of the machinery space, and also forward and aft peak bulkheads. Ships with the machinery right aft may have three bulkheads. The peak bulkheads may limit the influx of water due to injuries near the stem or the sternpost and thus save the ship from disaster. But the bulkheads forward and aft of the machinery space (when there are only three or four) are for convenience of service, and the ship will be lost if either the forward or aft holds are flooded. The exception to this statement occurs when the holds are full of cargo lighter than water, like lumber or cotton. Small vessels must put up with these conditions because the holds cannot be subdivided without too serious interference with service. There is no use in subdividing a ship for safety, if it is consequently put out of service. As ships become larger, and especially longer, the subdivision of the holds may proceed without undue interference with the service. The transatlantic passenger ships were so subdivided that their safety after collision (should that occur) was considered sufficient; but the loss

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of the *Titanic* showed that this confidence was misplaced. It was after this disaster that the international convention was called.

Results of the Convention

The convention expressed the result of their labors in connection with the determination of the proper load line for a ship and (concomitantly in connection with the discussion of bulkheads and subdivision) in the terms of *floodable length*. Speaking in general terms, the floodable length is the length between bulkheads that can be allowed without too much danger of the immediate loss of the ship should the compartment be filled with water by collision or otherwise. But before giving the formal definition of floodable length, the convention determined a *margin line*. This line is defined as being located three inches below the *bulkhead deck*. The *bulkhead deck* (if continuous) is the deck to which all bulkheads subdividing the holds are to be carried. Discontinuous bulkhead decks will be considered later.

Now the convention found it necessary to compromise between the desire to prescribe sufficient subdivision of the hull to ensure safety after collision and the necessity of avoiding undue interference with the service of the ship. This compromise is made by a factor for subdivision. This factor varies from unity to 0.34, depending on the length of the ship. The factor unity leads to the condition that *one* compartment may be flooded without losing the ship; the factor 0.05 gives a like condition when two adjacent compartments are flooded; the factor 0.34 appears to fall short of providing that three compartments may be flooded. But other conditions ameliorate this requirement so that 0.34 yields immunity when three adjacent compartments are flooded. The convention gave the following table:

Factor of Subdivision	Length of Freight and Passenger Vessel (Feet)	Length of Passenger Vessel (Feet)
1.00	295	259
0.90	374	285
0.84	404	305
0.65	489	380
0.50	571	489
0.39	609	685
0.34	899	899

This table shows that ships 259 feet long are one-compartment ships, in that only one compartment may be flooded without immediate danger. Ships 489 feet long are two-compartment ships, and only ships 900 feet long arrive at the dignity of three compartments.

Permeability

The amount of water that can enter a flooded compartment is limited by the material already there. This is defined by the *permeability*, which is the ratio of the water entering to the empty space. There are three degrees of permeability named by the convention:

(1) *Sixty percent* in cargo spaces, bunkers, baggage rooms, etc.
(2) *Eighty-five percent* in machinery spaces, including boiler rooms.
(3) *Ninety-five percent* in passenger and crew spaces, peaks, double bottoms, etc.

Floodable Length

We may now define the *floodable length* at any point along the hull as the percentage of the length of the ship that can be flooded without bringing the ship below the margin line, taking account of permeability and the factor for subdivision.

Let us try to visualize what this provision means. Suppose that the fore hold is 200 feet long and that the floodable length as computed is 70 feet, then there clearly must be two bulkheads in the hold between the boiler room bulkhead and the fore peak bulkhead; they need not be equally spaced provided no compartment is more than 70 feet long. Finally, it is specified that no compartment shall be more than 92 feet long. Again, the length of the forepeak tank is required to be at least 0.05 of the length of the ship. Ships which have a greater degree of security than required by the convention are to have that fact entered on their Safety Certificate. In a general way, we may conclude that all passenger ships will have one or two bulkheads in each of the fore and aft holds; long ships will have a larger number.

Floodable Length Diagrams

The greatest constructive work of the committee appointed by the Board of Trade is presented in the form of diagrams for determining the floodable length of a ship conformable to the requirements of the convention. These curves enable a designer to determine this condition during the preliminary design.

The committee advises that the determination of floodable length by aid of the diagrams be accepted without reservation and that subsequent computations after the design is completed need not be made. Anyone familiar with the labor and uncertainty of such calculations can understand the importance of this work of the committee. There are twenty-three plates of floodable length diagrams, twelve for a permeability of 60 percent and eleven for 100 percent; percentages between 60 and 100 require interpolation, but since such interpolations are for 80 percent or more the interpolation is quite satisfactory. The floodability diagrams vary with (1) the freeboard ratio, (2) the block coefficient, (3) the ratio of freeboard to draft, and (4) the sheer. It has been found in practice that the diagrams can be used without undue difficulty.

The report of the committee gives also diagrams for determining coefficients of water plane area, moments of inertia and centers of flotation; also curves of sectional areas for standard forms. Thus the designer has the means of investigating the initial stability of his ship while the preliminary design is under way.

Modification for Varying Types

When the subject of freeboard and subdivision of the hold has been settled for ships with a continuous bulkhead deck the trouble has just begun, because ships which are for all sorts of purposes and designed to avoid excessive port dues in various services take a multiplicity of forms, such as well decked ships, ships with raised forecastles and ships with long poops extending even to the bridge; also shelter deck ships and ships with long bridge houses amidships. All these matters, and also the effects of continuing certain bulkheads to a deck higher than the bulkhead deck are considered by the committee. They also have recommendations for ships that vary their passenger accommodation by interchanging certain spaces between passengers and freight. A very sensible suggestion for such ships is that they shall have two load lines, especially if they habitually carry more passengers one way than the other.

The committee further gives consideration to the fitting of longitudinal bulkheads, especially in the form of side bunkers, and suggests that allowance be given for suitable use of such means of limiting flooding of the hold. But the committee merely calls attention to the danger of a list due to flooding a side compartment either from

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loss of stability or from interference with lowering boats. In the same place the committee deals with the desirability of fitting inner skins along the side of the ship. Many other items are considered by the committee which cannot even be mentioned without leading to confusion or else to undue prolixity.

The convention considered the matter of doors in bulkheads and means of controlling them, and here again the committee offers practical suggestions looking toward guarding the integrity of the compartments without interfering with necessary access to them.

It may not be too strong a statement to say that no working ship can be made unsinkable; the only exception is the lumber schooner with the hold full and the deck load washed overboard.

STRENGTH OF BULKHEADS

Any regulation for subdivision must be a compromise. But there is another aspect of the bulkhead question where compromise should not be tolerated, and that is the matter of strength. Only too many reports of collision give sensational accounts of the heroic efforts of the ships' officers to stay bulkheads that begin to yield under excessive pressure. There is no discount on the heroism, but what shall be said of the shipbuilder who puts in a bulkhead too flexible to stand up under service?

Now the computation for a bulkhead frame or stiffener is a straightforward problem for the constructor. It may have its uncertainties due mainly to the difficulty of properly securing the ends, but they can be met either by looking after fastenings or by reasonable allowances in computation. It is not too much to say that a bulkhead with frames intelligently designed will not fail; the failure is due to insufficient stiffeners ill-secured at the ends. An insufficient bulkhead will pull loose at the rivets around the edge and either fail altogether or leak so fast that the next compartment is soon flooded. Not a little of the fault lies in the use of the term "stiffener," which carries the assumption that the plating is the bulkhead and that undue bulging can be reduced by riveting stiffeners to the plating. It should not be necessary at this time to insist that the framing of the bulkhead must carry the load and the plating is riveted to the framing to stop the flow of water. Indeed, if the framing is insufficient the plating may bulge if it wants to; it cannot get away and will only leak a little.

Now the real trouble about bulkheads is that except in tankers and similar ships no bulkhead is tested in regular service as is the frame and plating of the ship. A ship being a riveted structure is likely to give signs of weakness long before it will fail; there may be a chance for strengthening the ship, and at any rate future ships may take warning. But any bulkhead appears to be sufficient until it is tested, and testing bulkheads (except in tankers) is practically impossible, either under construction or in service. A ship is likely to be strained when a large compartment is filled, say nothing about interference with service. In 1898 a bulkhead in the U. S. S. *Illinois* was tested by Naval Constructor J. J. Woodward and reported to the American Society of Naval Architects and Marine Engineers while on the building slip. The writer is not aware that so complete a test has been made since in the United States.

The Board of Trade Committee procured the construction of a steel cofferdam simulating the conditions of a bulkhead and with methods of construction habitual for ship work. Various forms of stiffeners were used such as angles, bulb angles, channel bars and double flange plate stiffeners. Proper attention was given to securing the ends. The committee properly requires that every stiffener shall be able to carry its load without undue deflection and shall not depend on any assistance from the diaphragm action of the plate.

Tables of scantling for stiffeners with 30-inch spacing are given by the committee, based on computations and checked by comparison with experiments on the cofferdam.

COASTWISE VESSELS

The local committee has made a brief report giving recommendations for reasonable provision for safety of ships in the local sea service in the British Empire. Such vessels are usually small and the conditions that can be imposed without interfering unduly with service are few and simple.

Mention has been made of the committee appointed by the Secretary of Commerce to deal with bulkheads and subdivision of the hold, and of the subcommittees for the Atlantic coast, the Pacific coast and the Great Lakes. We can await the results of their deliberations with confidence. It, however, may not be out of order to point out the difficulty of their tasks, which are indeed different, but with certain elements of similarity.

In a recent number of this publication is the description of a new passenger ship for service on the Pacific coast, and not under the jurisdiction of the United States. It has all the characteristics of the passenger and freight steamer of the American type. It is about 250 feet long, has a draft of 13 feet and the bulkhead deck is 3 feet above the load waterline. It has bulkheads forward and aft of the machinery space and the usual forward and aft peak construction. The two holds and the machinery space are undivided. The ship has a deck 10 feet 6 inches above the waterline, but the space under this deck is used mainly, if not exclusively, for passengers and is practically open fore and aft for the length of the ship. The ship is fitted for 330 passengers and has a crew of 56 men. Intact such a ship is able to make fairly long voyages safely in the open sea. As for subdivision it has none. It is shown as fitted with six lifeboats that can carry 150 persons. A superficial examination of the plans leads to the conclusion that the designer has probably done all that he could. The provision for saving life appears to be an effective coast guard.

Naval Architects' Meeting

The twenty-eighth general meeting of the Society of Naval Architects and Marine Engineers will be held on November 11 and 12 in the Engineering Societies Building, 29 West 39th Street, New York. The annual banquet will be held in the Waldorf-Astoria Hotel on Friday evening, November 12.

SHIPMENTS TO THE PHILIPPINE ISLANDS.—G. W. Cruickshank, Zamboanga, P. I., who is in the market for steam specialties, writes to MARINE ENGINEERING that it is very hard to obtain machinery or supplies from manufacturers in the United States for the reason that the majority of them seem to think they are corresponding with their next door neighbor. Although they send descriptions of their products, they do not quote prices, necessitating six months' delay before an order can be placed, which means nine months before the goods can be delivered. Our correspondent believes that the export trade to the Philippines is going to be of considerable importance in the near future, and American manufacturers should wake up to this opportunity.

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Relation of Beam to Height of Metacenter

BY F. M. HIATT

Naval architects ordinarily consider the metacentric height of a vessel (i. e., the distance between the center of gravity and the transverse metacenter) as one of the principal factors governing the behavior of a vessel at sea. In the early stages of design the height of the center of gravity is estimated and to determine a satisfactory design with respect to sea behavior a suitable metacentric height is chosen. Together these fix the height of metacenter above base desirable for the case in hand. For any given design beam is the principal dimension which most affects the height of metacenter, but other factors enter into the problem to a greater or lesser extent. The water plane coefficient and the shape of water plane, the form and fullness of the underbody, the size of the vessel and the ratio of beam to draft all have their effects.

THE purpose of this paper is to present the derivation of certain curves which enable one, in the first stages of design, to determine quickly the height of metacenter above the base, which will result from any desired combination of dimensions and form-coefficients.

The curves here presented are based upon Normand's formula for height of the center of buoyancy and the ordinary expression $BM = \frac{I}{V}$. The latter of these two formulae is mathematically accurate. The former probably needs no defense, but it may be well in passing to state that a study of some fifty or more ships indicates for it a very close degree of accuracy. Ships of all types and sizes were included in a comparison between the height of the center of buoyancy by Normand and by detailed calculation. In most cases the error by formula was found to be less than one-tenth of a foot, but in a few cases it was as high as two-tenths. In one case an error of nearly five-tenths was noted, but in fairness to the formula it must be stated that the information for this ship was of doubtful reliability, and the case is here noted to indicate a possibility rather than a probability of error in cases of eccentric design. The study indicates that curves based upon these two formulae will, in practically all cases be accurate within one-half of one percent.

Derivation of Curves

In the following derivation the base line is taken at the under side of the flat plate keel.

L = length of load waterline in feet.
B = beam on load waterline amidship in feet.
H = mean draft in feet to load waterline (measured from base line).
M = height of metacenter above base in feet.
l = longitudinal or prismatic coefficient.
m = midship section coefficient = $\frac{\text{area of midship section}}{BH}$.
b = block coefficient.
p = waterplane coefficient = $\frac{W}{LB}$.
v = vertical prismatic coefficient = $\frac{lm}{p}$.
I = moment of inertia of load waterline in square feet × feet².
W = area load waterline, square feet.
V = volume of displacement, cubic feet.
ρ = radius of gyration of load waterline in feet.
K = a factor hereafter described as the inertia factor of load waterline.
CB = height of center of buoyancy above base in feet.
BM = distance from center of buoyancy to M in feet..

Normand's formula may be put in the form

$$CB = H - \tfrac{1}{3}\left(\frac{H}{2} + \frac{V}{W}\right) \tag{1}$$

and

$$BM = \frac{I}{V} \tag{2}$$

then

$$M = \frac{I}{V} + H - \tfrac{1}{3}\left(\frac{H}{2} + \frac{V}{W}\right) \tag{3}$$

but

$$V = lmLBH$$
$$W = pLB$$

and

$$I = \rho^2 W = \rho^2 pLB$$

whence by substitution and rearrangement (3) becomes

$$M = \frac{\rho^2 p}{lmH} + \tfrac{5}{6}H - \frac{lm}{3p}H \tag{4}$$

Now the radius of gyration ρ is a linear quantity and we may let

$$\rho = \sqrt{K}B \tag{5}$$

in which K is a constant for any given water plane and K remains the same for that water plane for all beams or lengths to which it may be expanded. It is especially to be noted that we may expand a plane by one ratio for beam and by another ratio for length without change in the inertia constant K.

Substituting this value for ρ in equation (5) we get

$$M = \frac{Kp}{lm}\frac{B^2}{H} + \tfrac{5}{6}H - \frac{lm}{3p}H \tag{6}$$

and remembering that $\frac{lm}{p} = v$, this may be written

$$M = \frac{K}{v}\frac{B^2}{H} + \left(\tfrac{5}{6} - \frac{v}{3}\right)H \tag{7}$$

This is the equation upon which the curves here presented are based. K is the inertia parameter. Its absolute value is dependent upon the shape of the water plane to be used, and the same will be discussed presently and a chart presented, enabling one to choose readily a value appropriate for any given case. v is a parameter dependent upon the underwater form of the vessel. Since l, m and p are chosen in the very early stages of design, a simple slide rule operation quickly determines the proper value of v.

With K and v fixed, let us assume some value for M. Since K and v are always positive and v is never greater than 1, the resulting curve is an ellipse in B and H. We may call this an iso-M ellipse. Plate I shows such an

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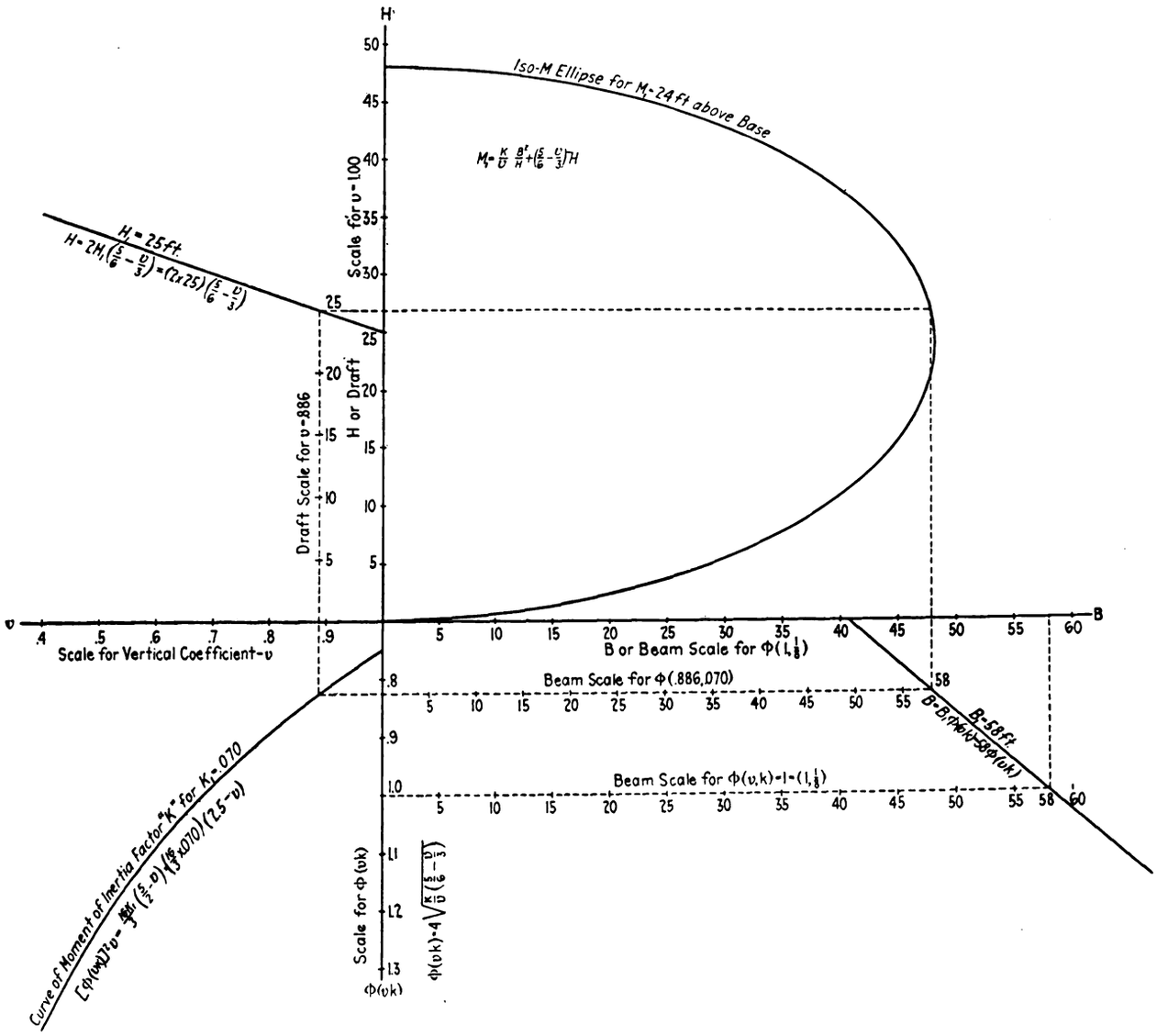

Plate I

ellipse. For that ellipse v was taken equal to 1, K equal to 1/8, and M was assumed equalling 24. Obviously other ellipses for other values of M, but for the same values of v and K, could be plotted on the same sheet and referred to the same axes. Such a sheet would solve equation (7) for all heights of metacenter provided v equalled 1 and K equalled 1/8, but, as it happens, in practice v rarely equals 1 and K never equals 1/8. It does happen, however, that these assumed values result in ellipses of suitable character for our use and, properly treated, such a series may be made to solve our equation for any and all values of v and K.

Mathematical analysis develops the facts that the H axis of any iso-M ellipse equals

$$\frac{M}{\left(\frac{5}{6}-\frac{v}{3}\right)}$$

and the B axis equals

$$\frac{M}{\sqrt{\frac{K}{v}\left(\frac{5}{6}-\frac{v}{3}\right)}}$$

There are three facts to be noted in connection with the axes of these ellipses: (a) Division between the axes results in an expression in v and K with M eliminated; (b) the H axis is a function of M and v only; (c) the B axis is a function of M, v and K.

Returning to Plate I, since (a) is true, for $M = 24$, we can use the ellipse there plotted to solve equation (7) for any values of v and K, provided we append new and proper scales for H and B. Since (b) is true, the H scale will be a function of v and M, and since we intend to use this ellipse for only one value of $M = 24$ and will add other ellipses for other values of M, we may say the H scale is a function of v and a constant. Finally, since (c) is true, the B scale must be a function of K, v and M, which may be taken as K, v and a constant.

The ellipse in the figure might have been plotted for any value of M. To make the case general, let us assume that M equals any fixed value M_1. Remembering that $v = 1$, the H axis equals $2M_1$, let us assume that this axis is measured in units H_1. In general, for other values of v and for $M = M_1$, the H axis equals

$$\frac{M_1}{\left(\frac{5}{6}-\frac{v}{3}\right)}$$

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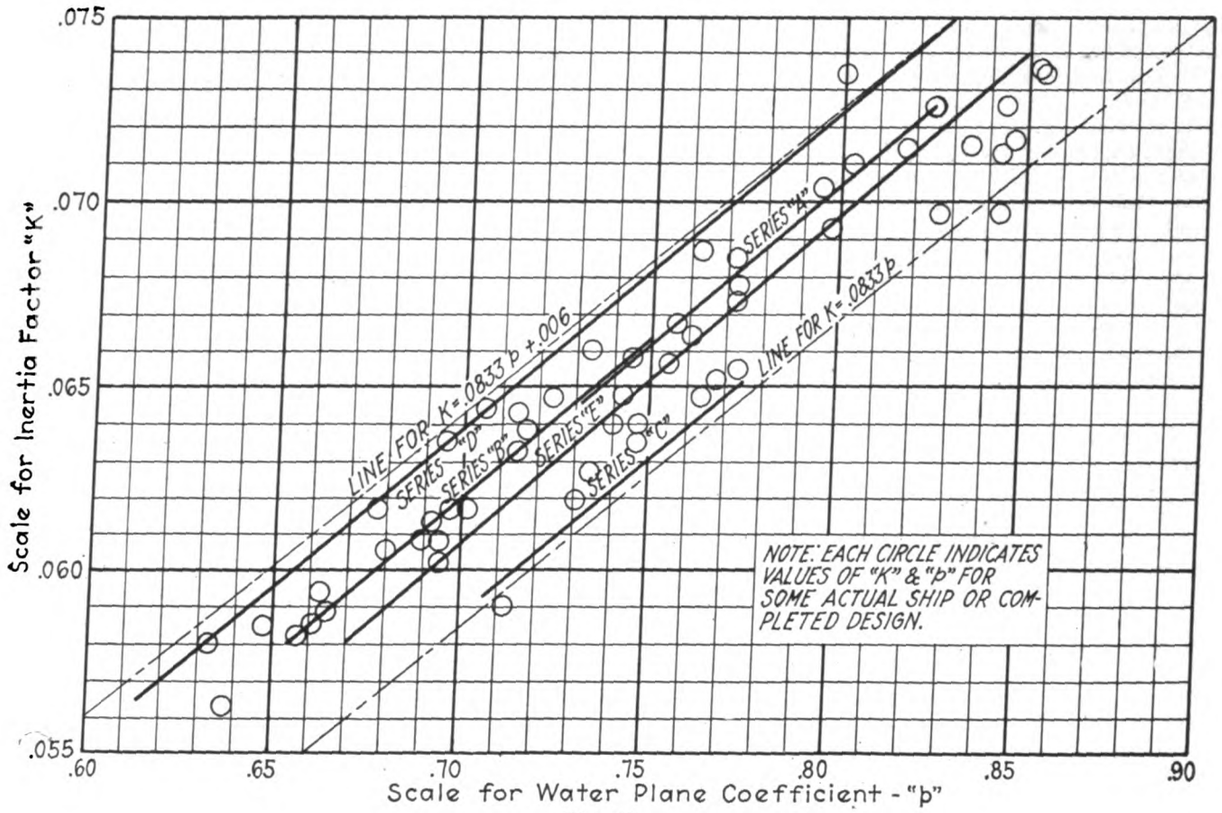

Plate III

In the general case let the H axis be measured by the variable unit H. Now since we desire to use this same ellipse for all values of v, we may say

$$\frac{M_1}{\left(\frac{5}{6} - \frac{v}{3}\right)} H = 2 M_1 H_1 \qquad (8)$$

and considering v and H as our variables, we have an equation for our variable H scale. From this expression M_1 eliminates upon simplification and (8) may be written

$$H = 2\left(\frac{5}{6} - \frac{v}{3}\right) H_1 \qquad (9)$$

This is the equation of a straight line. By substituting successive values for H_1, the corresponding successive markings of our draft scale may be determined. The upper left-hand quadrant of Plate I shows a draft line for a value of 25 feet. It will be noted that the v axis is taken coincident with the B axis, but the origin for the draft line in H and v is to the left of the origin for the ellipse in H and B.

Turn now to the variable scale for B. The ellipse being plotted for $v = 1$ and $K = \frac{1}{8}$, the B axis of the ellipse equals $4M_1$, but in general the B axis of an iso-M ellipse equals

$$\frac{M_1}{\sqrt{\frac{K}{v}\left(\frac{5}{6} - \frac{v}{3}\right)}}.$$

Let the first be expressed in fixed units B_1 and the second in variable units B. Then

$$\frac{M_1}{\sqrt{\frac{K}{v}\left(\frac{5}{6} - \frac{v}{3}\right)}} B = 4 M_1 B_1 \qquad (10)$$

which is our equation in B, v and K for our beam scale. Simplified, (10) becomes

$$B = 4\sqrt{\frac{K}{v}\left(\frac{5}{6} - \frac{v}{3}\right)} B_1 \qquad (11)$$

Since we are working in two dimensions only, we cannot plot equation (11) directly, because it contains three variables v, K and B. To eliminate one variable, let

$$4\sqrt{\frac{K}{v}\left(\frac{5}{6} - \frac{v}{3}\right)} = \phi\ (vK) \qquad (12)$$

and equation (11) may then be written

$$B = B_1\ \phi\ (vK) \qquad (13)$$

In Plate I it will be noted that a suitable scale for $\phi\ (vK)$ has been marked, the $\phi\ (vK)$ axis being coincident with the H axis, but with the origin above the origin for the ellipse. Equation (13) is a straight line in B and $\phi\ (vK)$. Substituting successive values for B_1 will produce the successive markings for our variable B scale. A beam line for $B = 58$ is shown in the plate.

We must now provide a means for evaluating $\phi\ (vK)$. Fortunately we have remaining one unused quadrant with one axis already laid off with a suitable v scale, while the other is marked with a scale for $\phi\ (vK)$. As marked, the origin between these scales is above the horizontal and to the left of the vertical axis. Equation (12) may be written in the form

$$[\phi\ (vK)]^2 v = \frac{16K}{3}\left(\frac{5}{2} - v\right) \qquad (14)$$

from which it appears that in general the curve is a modified form of the Witch of Agnesi. If K equals 75/64, the curve becomes a true Witch, the generating radius of which is 1.25. Let us assign successive values to K and

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plot the resulting curves in v and ϕ (vK). On Plate I one such curve is shown for a value of $K = .07$.

We now have one ellipse for $M = 24$, one draft scale mark for $H = 25$, one beam mark for $B = 58$, and one K curve for $K = .07$. The dotted lines indicate the solution of equation (7) for a value of $v = .886$. To be able to solve the equation for general cases, ellipses for other values of M must be added, likewise draft and beam scales must be completed and we must add curves for other values of K. Plate II has accordingly been prepared. By means of this plate the general equation may be solved for any values of v, K, M, B and H commonly met with in practice. The method is in general the same as that indicated in the preceding plate.

As noted earlier in the discussion, v is readily calculated by slide rule ($v = \frac{lm}{p}$), but if the curves are to be of material benefit, we must know what value of K may be suitable for any given design in hand.

It is at once apparent that K may be varied either by a change in water plane coefficient or by altering the shape of the plane, either with or without a change in p. Actual values of K for a number of water planes have been computed and the results of this study are indicated on Plate III. Each circle indicates the value of K for some actual ship. This study covered ships of all types and sizes and indicates that in the zone of good practice K has a value lying between $.0833p$ and $.0833p + .006$. It is possible that extreme types may be encountered with values outside these limits.

In general, pronounced shoulders and fine ends tend toward high values of K for a given water plane coefficient, while fining of the plane amidships with a filling out at the ends, as in cruiser sterns or broad stern speed boats, lowers the value of K. For the purpose of visualizing the relation between K and the water plane shape, Plate IV has been prepared. Figs. 1, 2 and 3 thereon show certain standard series of water planes. These series were prepared by Mr. J. L. Bates, and thanks are due to the *Shipbuilding Cyclopedia* for permission to reproduce them here. Figs. 4 and 5 have been added to illustrate other variations in water planes. Curves of K on a p base for all of these series have been plotted in Plate III. It is believed that a passing study of these plates will enable one to choose a suitable value of K from the insert in the upper right-hand quadrant of the plate of curves. In case one has certain water plan s for standard use, it might be found worth while to compute values of K for such planes and mark them in the figure.

In the quadrant of Plate II, where the K curves are plotted, it will be noted that intermediate values of K to the nearest .001 are shown over a limited space only. It will be found that this is the area of good practice and that values much outside of this area are indicative of eccentric design.

As an illustration of the use of the curves, assume that we have in hand the design of a ship of 17,000 tons displacement on a draft limited to 28 feet. It is proposed to use a midship section coefficient of .96, a prismatic of .77, and a water plane in general similarity to the type of plane shown in Series *A*, Fig. 1 of Plate IV. The water plane coefficient chosen is .82. For this ship a height of M above base of 25 feet is desired.

$v = .901$.

Referring to the insert on Plate II, for the type of plane selected (Series *A*) a value of $K = .072$ is indicated as corresponding to $p = .82$.

Enter the plate of curves on the horizontal axis at $v = .901$ and lay a ruler or a strip of paper perpendicular to the horizontal axis. This marks at once the proper H or draft scale to use. The proper B or beam scale is found running horizontally from the intersection of the curve for $K = .072$ with the line of the H scale produced. On the ellipse for $M = 25$ we find that for a draft of 28 feet a beam of 59.5 feet will be required to obtain the desired height of M. This draft and beam with the coefficients used calls for a length on the load waterline of 483 feet to give the required displacement of 17,000 tons. If this length meets the needs of the case, the problem is solved. If the length is not suitable, we of course have the usual options in compromising between conflicting interests. However we may desire to effect this compromise, the curves will readily solve the equation in accordance with any assumptions made.

This paper would perhaps be incomplete without mention of other possibilities in the way of plotting. Th equation here treated as an iso-M ellipse in H and B might have been considered as an iso-B hyperbola in H and M or an iso-H parabola in M and B. The possibilities of the hyperbola and the parabola were investigated in some detail, but for a general set of curves of universal applicability the ellipse seemed best to fill the needs of the situation and for that reason was here chosen. The H parabola was apparently inferior in all respects to either of the other curves.

If, however, standard waterlines are established, and especially if these are associated with standard sectional area curves, the hyperbola in H and M possesses some advantages. Reference has heretofore been made to certain standard water planes established by Mr. J. L. Bates and appearing in the *Shipbuilding Cyclopedia*. These water planes are associated with certain sectional area curves, so that when one chooses a longitudinal coefficient suitable for any design, the sectional area curve is thereby determined; and associated with that sectional area curve is a suitable water plane. Thus l, p and K are determined by once choice of l. To evaluate the expressions $\frac{Kp}{lm}$ and $\frac{lm}{3p}$ appearing in equation (6), a choice of midship section coefficient m is then necessary. A series of sheets of iso-B hyperbolas is then submitted for various values of m, and interpolation may be resorted to for values of m lying between two sheets.

One advantage of these standard curves which seems immediately apparent lies in the fact that the water planes have been so chosen and have been related to the standard sectional area curves in such a manner that one may alter the longitudinal coefficient at will without changing the height of M, the effect of the change in l being counterbalanced by an automatic change in the water plane. This in effect reduces the number of variables entering into the problem of preliminary design and thus reduces its complexity.

On the other hand, one advantage of the curves here presented lies in the fact that they are not associated with any standards but are applicable to any and all ships alike. Anyone desiring to establish standard planes may readily compute values of K for such a series and thus make his reading of the plate somewhat more accurate. It is believed, however, that for ordinary purposes of preliminary design this will not be found necessary.

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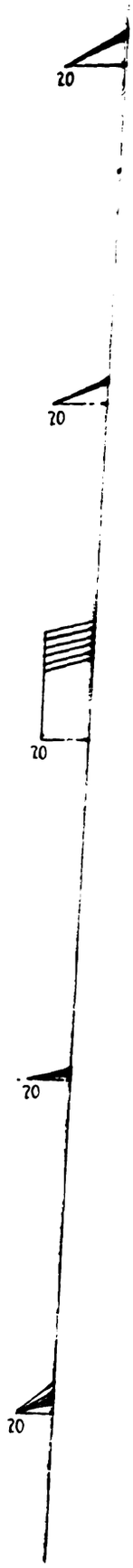

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Standardization of Ships' Details

FOR three years shipbuilders in Great Britain have been considering the standardization of ships' details, principally deck and other fittings. This movement was taken up in 1917 by the North East Coast Institution of Engineers and Shipbuilders with the formation of a ships' fittings committee, whose first report, presented in April, 1919, recommended standards for bollards, fairleads, mooring pipes and hawse pipes. Subsequently this committee was replaced by the North East Coast Institution Panels which are carrying on the work in conjunction with the British Enginering Standards Association. The details at present under consideration of the Panels are as follows:

Panel 1.—Bollards, fairleads and mooring pipes. Panel 2.—Hawsers, ropes, rigging screws and rigging gear. Panel 3.—Boat davits, derricks, derrick fittings, stanchions, all ladders and ladder fittings. Panel 4.—Windlasses, capstans, winches, steering gears and deck machinery. Panel 5.—Deck and hatch fittings, watertight doors, manhole covers, sidelights, ventilators, bunker and galley fittings. Panel 6.—Cabin fittings and beds, including electric light fittings not dealt with by the electrical committee. Panel 7.—Sanitary fittings and all pipe and pumping arrangements. Panel 8.—Anchors, cables and chains.

The North East Coast Panels will be augmented by representatives from the Board of Trade, the classification societies and the North East Coast shipbuilding and ships' auxiliary manufacturing companies, and they will also co-operate with similar panels established in the Clyde shipbuilding district.

A New Departure in Side Launching

SOMETHING unique in the annals of side launching has been successfully accomplished on the *Canadian Otter* built to the order of the Canadian Government by the British American Shipbuilding Company, Ltd., Welland, Ont.

The ship's dimensions necessitated the usual cutting for passage through the Welland Canal. To eliminate the cost and time of dry docking for this purpose, the hull, while on the stocks, was first fitted complete, but later a section of plates just forward of the boiler room bulkhead was unbolted, removed and marked for reference.

The weights at launching condition and the centers of gravity of each part were calculated and the loose plates stowed in the fore end for trimming. A temporary watertight wooden bulkhead was fitted near the break to prevent the flooding of the forward hold and also to insure greater buoyancy.

There was a drop to the water of 5 feet 4½ inches for the after end and a drop of 3 feet 6 inches for the forward end. From observation the greatest angle of heel was found to be 34 degrees, and the time elapsing from starting to reach this position was 6 seconds. In three seconds more she righted herself and lay on a comparatively even keel.

A sister ship is on the stocks at present and will be launched in a similar manner in the near future.

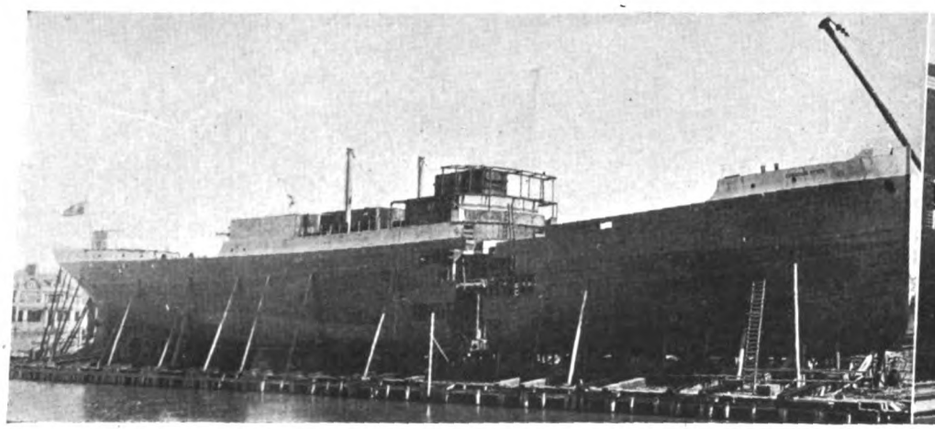

Fig. 1.—S. S. *Canadian Otter* Cut Apart on the Ways to Enable Her Passage Through the Welland Canal

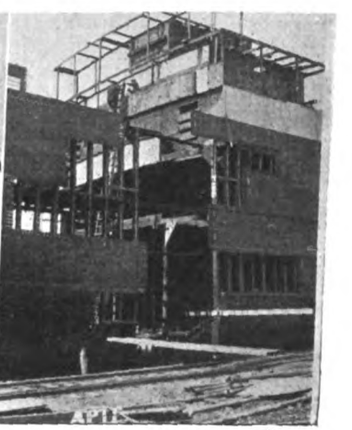

Fig. 2.—Section Where Shell Plates Were Removed

Fig. 3.—Launching the After Section

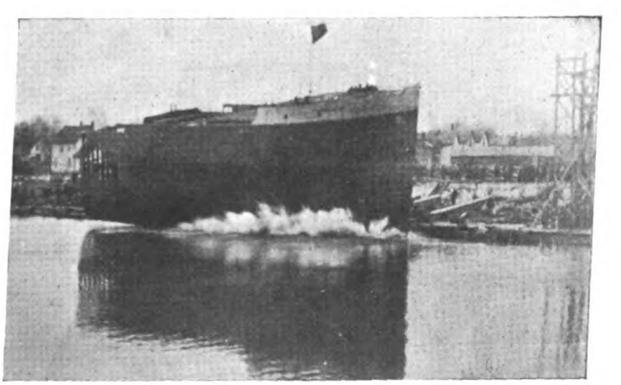

Fig. 4.—Bow Section Entering the Water

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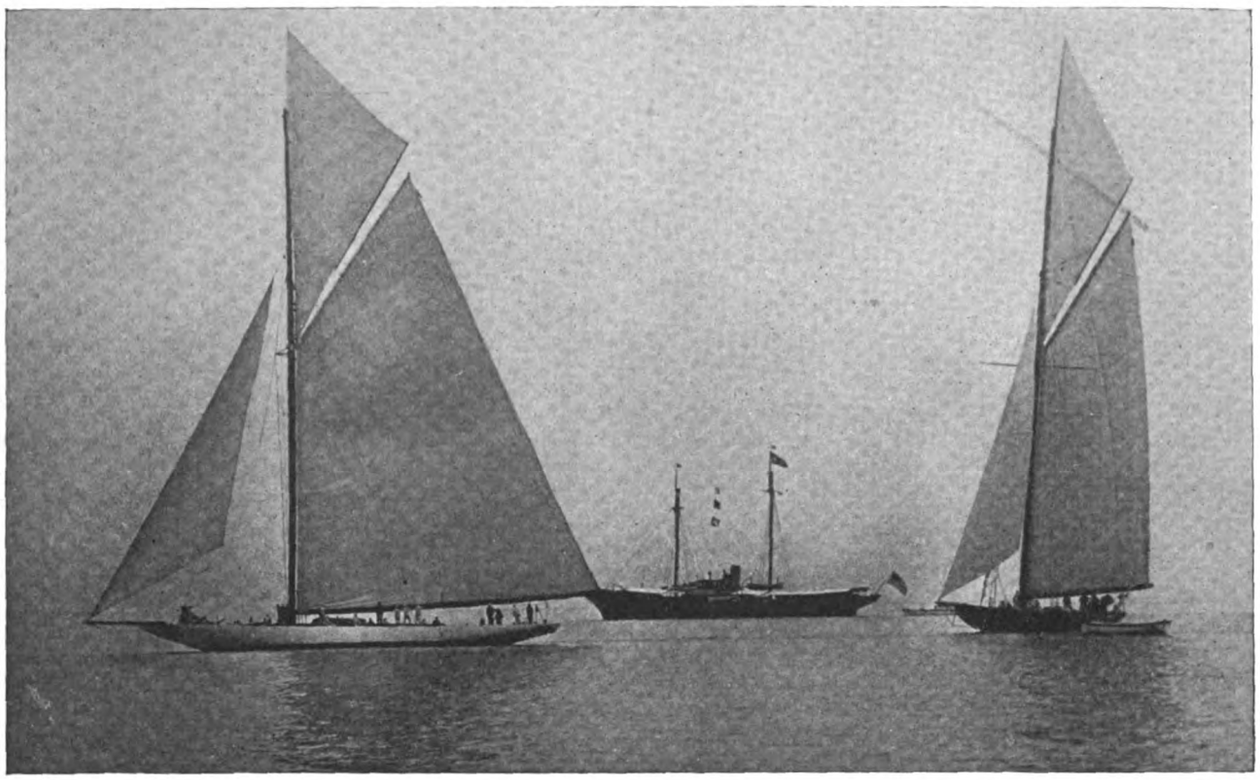

(*Photograph copyright by International, N. Y.*)

Fig. 1.—*Resolute* Leading *Vanitie* at Start of First Elimination Race Off New Haven, Conn.

The International Yacht Race

BY C. A. MC ALLISTER

NAVAL architects and others interested in the building and operation of ships are certainly entitled to a diversion after more than five years of strenuous efforts to produce tonnage, both naval and mercantile, to fill up the gaps caused by the rapacious submarines. After the seriousness of that great undertaking, the pull-

Fig. 2.—Crew of *Resolute* at Work on New Mast

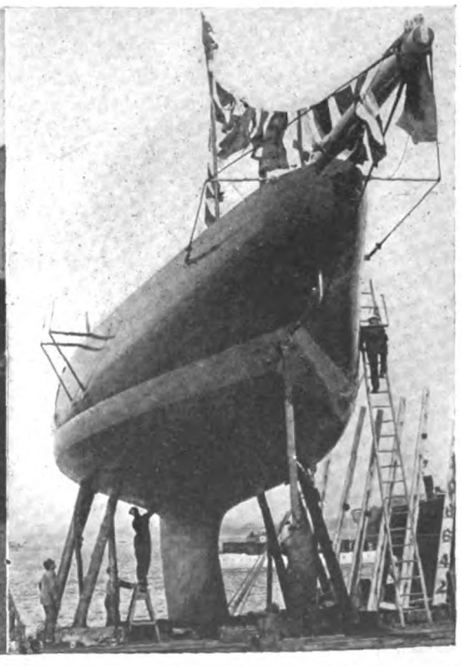

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Fig. 3.—Launch of *Shamrock IV* at City Island, N. Y.

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ing off of a real, old-time, sure-enough international yacht race will have a tonic effect on the jaded nerves of mariners afloat and ashore. It hardly seems possible, but it is a fact, nevertheless, that the last race for the Queen's cup was held in 1903, just seventeen years ago; it is high time, therefore, to have another chapter of these great events.

Of course, this coming race was originally scheduled for the year 1914, and the challenger, the *Shamrock IV*, had arrived and was making preparations for the contest that year when the event was called off, owing to the outbreak of the great war. The American yachts, the *Vanitie* and *Resolute*, had about completed their trial races, but no decision had been made as to which of them should be selected for the honor of defending the cup. Consequently, the preparations for the great contest this year have been merely a taking up of the programme so rudely set aside six years ago. Opportunity has been taken, however, of making slight improvements in all three yachts. These changes have now been completed, and whether or not they are betterments over the original design will probably never be known. In the case of the visiting yacht the alterations were comparatively extensive, embracing, as they did, the cutting of about 6 tons of lead from the keel, altering the rake of the rudder and performing an extensive marine surgical operation on the forefoot, whereby hollow lines were replaced by convex lines, with the evident intention of shortening the waterline length, which largely determines the sometimes vital question of time allowances.

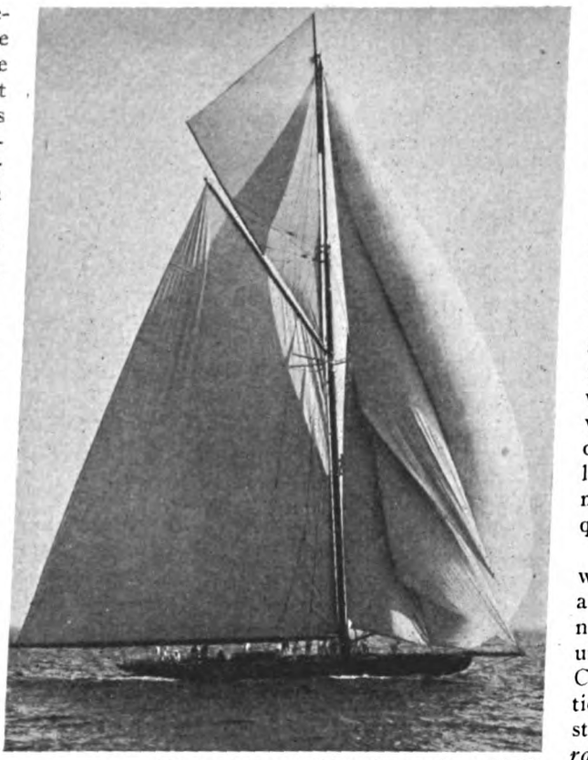

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Fig. 4.—*Shamrock IV*, the Challenger

The exact lengths of the waterlines of the contenders are not yet known, and will not be until the official measurer of the New York Yacht Club has executed his particular function. It is understood, however, that *Shamrock IV* as originally constructed would have had to give either of the Yankee sloops a considerable time allowance, which in a close race might have kept the cup on this side, regardless of

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Fig. 5.—*Resolute*

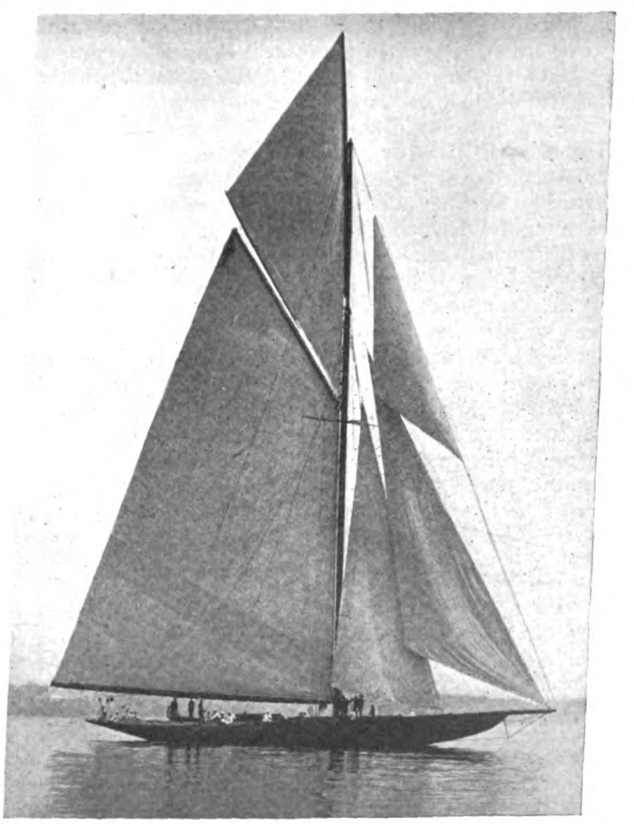

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Fig. 6.—*Vanitie*

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the elapsed time over the course. It may not be generally remembered, but the fact is that the race this year will be between sloops much smaller than those participating in the last four or five series of races. Whereas the *Columbia* and *Reliance* and the original *Shamrocks* were sloops of about 90 feet waterline length, the present contestants are all in the close proximity to 70 feet long on the waterline. To look at their spars and racing sails, however, it does not look as if there was such a great difference in size.

American Yachts Evenly Matched

At the present writing, June 11, the question of whether the *Resolute* or *Vanitie* will be selected as the defender of the cup is problematical. To date the honors are as nearly even as it is possible to judge them. In all three of the yachts the designers' ideas have been to get the maximum of driving power from sail spread with the minimum of weight. The margin of safety of spars and rigging has been reduced to a very small factor, as evidenced by the several mishaps which have already befallen the spars of both the *Shamrock IV* and the *Resolute*. The *Vanitie* has been more fortunate, or perhaps we could say that she has the advantage of a larger factor of safety in the design of her spars and rigging. In making the decision as to the best American yacht, the record of the *Vanitie* for freedom from mishaps should be given the most serious consideration. It will matter very little in the ultimate outcome of the race series if the American contenders may have been leading at a certain period of the race and lost out through the breaking of a gaff or the carrying away of a stay. It's the first boat over the finish line in the majority of the series which will take the cup. Accidents are no excuses. There is little use, therefore, in having the fastest boat unless she can hold together and get over the line first.

Should the *Vanitie* be selected, it will be bronze versus wood in the international contest—the most up-to-date material for ship construction pitted against the first material ever used by man to float on the seas, as it is reliably reported that Noah saved the human race by building his ark of wood. It is interesting to note, in retrospect, the varying conditions under which these classic contests have been run. Originally when the *America* went to England and took the cup it was a contest of radically different types, the Yankee skimming dish (broad beam, light draft and centerboard) against the generally accepted channel type of English cutter, with narrow beam and great depth. In succeeding races these radical differences of type have gradually been eliminated, as each side has by evolutionary processes adopted the best points of their antagonists. Today it would be rather difficult to differentiate between the contenders so far as type is concerned. The same long overhanging bows and sterns, the same types of lead keels, approximately the same beams, and each provided with dagger centerboards leave little points of difference in general to be discussed.

Distinguishing Features of the Contenders

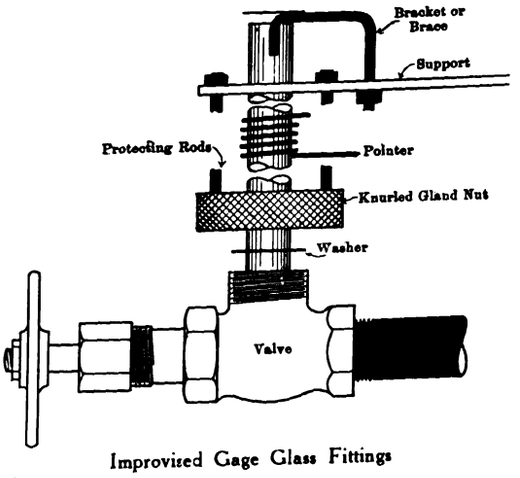
From a spectacular standpoint the approaching races will be well worth seeing to all who love ocean sports, and almost everybody does. Even though the contestants will be smaller sloops than those in the immediately preceding races, their enormous spars and sail spread make them easily distinguishable from any other yachts in these waters. Following precedent, Sir Thomas Lipton, out of loyalty to his native land, has the *Shamrock IV* painted green. If the *Vanitie* is selected, her polished bronze sides will glisten in the sunlight so that the contestants may easily be distinguished miles away. The British yacht ensign with the insignia of the Royal Ulster Yacht Club emblazened on the blue field will attract considerable attention, with its golden crown above a white circle, in which is worked a large bloody human hand, known as the Blood Red Hand of Ulster. Sir Thomas Lipton has in all his previous contests for the cup proved himself to be a prince of sportsmen, and all Americans wish him well, with the solitary exception that he does not take the much coveted cup.

Old timers at City Island, now the center of yachting activities in this country, who have seen all of the yachts for many years past, do not feel so sure but that Sir Thomas will be rewarded this year, for, as one of them stated as he shook his head ominously, "This will be the thirteenth of the series of races, and I never did like that number."

Gage Glass Fittings Made from Old Valves

AN inexpensive and servicable gage glass fitting for lubricating oil tanks or for any other low pressure oil storage tanks can be made from an old valve as shown in the illustration. In this case an angle valve is used, but a globe valve will answer the purpose as well.

A solid brass plug should be threaded and screwed into the valve as far as the valve is threaded. A hole the size of the inside diameter of the gage glass should be drilled through the plug. Next bore the plug out just large



Improvised Gage Glass Fittings

enough to admit the gage glass, leaving a shoulder on the plug for the glass to rest on.

The outside of the valve should be turned down just enough to true it up and then threaded with fine threads about 20 to the inch. A thin washer will answer the purpose of a stuffing box gland, as there will be no pressure to resist.

If no gage glass protecting rods are to be used, the gland nut should be made smaller. Three or four protecting rods are enough and are made from any small size stiff wire. One fitting will be enough, as the glass can be left open on top; 3/16-inch or ¼-inch flat stock will answer for the top support of the glass. To keep dirt from falling in the top, a cover can be made and soldered to the holding down rod or brace made from ¼-inch stock.

A coiled spring, as shown, is made to answer the purpose of a pointer, and after calibrating the tank and transferring the measurements to a scale on the outside the pointer can be moved from day to day showing the amount drawn.

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Turbo-Reduction Gears in Practice

BY COMMANDER H. C. DINGER, U. S. N.

Recent descriptions of turbo reduction gears for both naval and merchant vessels have dealt principally with the details of construction, the manner of cutting the gears, the economy resulting from their use and the advantage in weight saving over directly connected units. In this article, however, the author takes up from a practical standpoint the actual operation of the gears on the vessels, defects in installation, troubles in operation and the care required to avoid such troubles as have been encountered.

SATISFACTORY reduction gear sets of almost any power desired can be made by a considerable number of shops both in this country and in England. Furthermore, an enormous number of marine turbo-reduction gear sets are being made and are being operated. Practically all the pioneer sets made by Parsons have operated successfully from the start. Nearly all the sets built in the United States have been successful. Some failures have been due to design, others to inaccurate workmanship and installation, and a greater number to improper operation or failure of the lubricating system. Reduction gears are, in fact, no longer a novelty in marine work, and though the ultra conservative may not take much stock in the "new fangled contraption," which has at times given trouble, chiefly from the neglect to see that it got oil, marine gearing is here to stay for some time and may be looked upon as the accepted steam plant for all merchant craft, except for small powers where the reciprocating engine will still hold on for some time.

> The most essential thing for successful operation of the reduction gears is to have an absolutely reliable lubricating system and to be particularly careful that no water or dirt of any kind gets into the system. Water in the oil is extremely dangerous. A bearing may run with a little water in the oil, but the gear will not. The presence of lint or similar substances in the oil system is especially to be guarded against, since it may plug up the oil sprays. The importance of absolute cleanliness of the interior of the gear case cannot be exaggerated. The greatest possible care must be exercised that pieces of gasket material used in any of the joints in oil piping do not find their way into the oiling system. A very careful alinement and a close, accurate adjustment of the pinion bearings is essential, as any extra back lash will cause trouble.

Turbo-reduction gears are now largely fitted on both naval vessels and merchant ships. The gears are of different types and manufacture, namely, Parsons, Westinghouse, Falk, DeLaval, and gears made by the General Electric Company, including Alquist patents. Various other shops, including the Fore River plant at Quincy, have also made gear. The planetary gear made by the Poole Engineering Company has been successfully applied in the Ford *Eagle* boats. The Parsons and DeLaval gears employ comparatively small teeth and usually have a single reduction. The other gears usually have a coarser pitch and the Falk gears employed on Curtis turbines for destroyers have a much coarser pitch and larger teeth than are ordinarily employed by other makers.

Gears may be arranged for either single or double reduction. Single reduction gears have a gear ratio of 1-4 to 1-24. The latter figure is about as high as appears desirable to go with single reduction. If a greater reduction is necessary, a double reduction should be resorted to.

In naval work, single reduction sets are generally used, because the speed of the vessel is high and this permits of using higher propeller speeds than are considered desirable in the case of 10 or 12-knot freighters. A large number of merchant installations, therefore, employ double reduction sets. This makes a more clumsy gear set, but a more economical turbine and propeller, as it permits a high speed for the turbine and a low or economical speed for the propeller.

By some manufacturers the idea is exploited that for large marine reduction gears a floating frame or flexible alinement is necessary or at least desirable. As a matter of fact, most of the sets in operation, and this includes the largest ones installed in light, non-rigid vessels, are of the rigid type, and some have been in operation for many years. As far as practice has determined, a flexible gear is not necessary and moreover is probably less desirable than a rigid gear. What is required in a successful gear is minute accuracy and rigidity, adequate strength and absolutely reliable lubrication. In cases where a rigid non-flexible gear has been designed with adequate margin, and where there have been accurate workmanship and correct adjustment, they have worked with general satisfaction. On the contrary, numerous attempts to construct a gear that will be flexible have not been successful. In other words, an attempt to cure an assumed defect has introduced difficulties of much larger magnitude than the assumed one that is to be cured.

The following summation is made by one of the most successful manufacturers which has built marine reduction gear sets in the United States:

(1) The twisted or helical gear is the only type suitable for the transmission of large powers at high speeds, due to the fact that the load is transferred from tooth to tooth without shock or vibration.

(2) Helical gears should be double, with the teeth inclined at equal angles in order to eliminate axial thrust.

(3) For high pitch speeds the angle of the helix and the number of teeth must be so selected that the maximum number of teeth will be in contact at all times.

(4) The cutting apparatus and methods must be such that correct pitch, angle and tooth contour are produced. Hand correction or finishing will not produce a correct gear.

(5) The most suitable shape of tooth is the involute, which gives a true line contact on each tooth so long as the tooth is in mesh and irrespective of considerable variations in the distance between the centerlines of the shaft, as due to wear of bearings.

(6) After cutting, the teeth must be polished uniformly

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to remove scratches and inequalities left by the cutting tool. This can be done only by mechanical means and not by hand scraping or filing.

(7) The tooth pressure must not be so high that the film of oil will be squeezed out from between the teeth. This maximum pressure is influenced principally by the peripheral velocity.

(8) The gear and pinion must be rigidly supported so that their axes remain parallel. Only by this means can the teeth be made to retain their original correct contours, and to operate noiselessly, efficiently and without vibration. Flexible supports open up a way for vibration and momentum effects that otherwise would not exist. No flexible member can accommodate itself to inequalities of pitch of a rapidly revolving pinion or gear, on account of the short period of time in which adjustments would have to be made and the great momentum that would have to be generated or destroyed at each oscillation. Neither can a flexible frame or support compensate for bending of the pinion, and it cannot compensate for twist of the pinion correctly, since the twist per unit length varies from a maximum at the end of the pinion where the power is applied down to nothing at the free end. The fact that rigid frame gears are, and have been for years, running continuosly with high tooth pressures and at the highest peripheral speeds shows that the complications of a flexible frame are not essential to securing satisfactory operation.

Merchant marine work is characterized by continuous operation at full load, and for this reason it would not be wise to work with extreme tooth pressures, even were it possible to compensate correctly for distortion. By choosing properly the diameter of the pinion in relation to its length, cross bending and torsion become very small indeed. For example, in a 6.6-inch diameter pinion of 24-inch total face having three pinion bearings and transmitting 2,000 brake horsepower at 3,600 revolutions per minute, the extreme possible deflection due to bending is only .0005 inch, and the distortion due to twist only .00045 inch, making no allowance for distribution of the pressure by varying thickness of the oil film.

General Considerations

For medium powers, when space is not restricted, a gear can be used that has a good margin of tooth pressure, and the problem of securing a satisfactory gear is not a very difficult one. The metal is not stressed to any great extent, and a solid and rigid housing for the gear can be provided. However, when we come to the very high powers in confined spaces, such as are required on destroyers and scouts, the problem becomes much more difficult. Tooth pressures are high, the metal of pinions is highly stressed, rigidity of bearings and bearing supports is more difficult to secure and the lubricating problem is also more difficult. But, if a high degree of accuracy in the cutting of the teeth and in the alinement and adjustment of all the parts is secured, the problems are satisfactorily solved.

Lack of satisfactory conditions in regard to alinement and accurate mesh is usually indicated by noise, and such noise is intensified by lack of balance in the various parts.

By reason of even slight lack of accurate teeth and proper alinement, some gears may be very noisy. Sometimes this noise is reduced by some slight wear in service, but such improvement is not to be depended upon. If a noisy gear is present, it is a pretty safe guess that there is something wrong with the alinement of the bearings, the meshing or the cutting of the teeth.

Some very large gears, DeLaval, Parsons and Westinghouse, which are very heavily stressed, have been machined and installed with such accuracy as to be free from any objectionable noise.

Laminated Gears

A considerable number of gears built up of laminated rings have been built and tried. The principle examples of this type of gear have been put forward by the General Electric Company under Alquist patents. The idea of the laminations is to get flexibility and to permit of using small teeth. The practical results with these gears do not indicate that the desired results are secured. While quite a number have operated successfully when new, there have been a large number of cases of teeth breaking. In fact, the gear seems, in a very contrary manner, to do the very thing it was specially designed not to do. Apparently, in practice, wear is uneven on the several laminations and after a while the hard laminations take the load and become overloaded and then teeth are broken. In view of the fact that solid teeth with rigid bearings have given very satisfactory results in the course of years of service, there seems to be no reason to use laminations.

Lubricating Systems

The most essential thing for successful operation with reduction gears is to have an absolutely reliable lubricating system and to be particularly careful that no water or dirt of any kind gets into the system. For lubricating gears, a heavy straight mineral oil or mineral oil with a slight admixture of lard oil appears to give the best service. Lard oil should not be used unless absolutely needed, since the acid it contains may start corrosion. If a gear is scored or rough, it may be necessary to use lard oil for a time until the surface is again smooth.

In most cases, the lubricating system for the gears is the same as that for the turbine bearings. Here it is usually best to use as heavy an oil as the turbine bearings will stand. Light oils are usually better for the turbine bearings, while they are not best for the gears. But usually a mineral oil that will answer for both can be found. For the reduction gears, also, a fairly high oil pressure is desired, usually a higher pressure than would be required for the turbine bearings alone.

Different manufacturers have different arrangements for their lubricating system. In some types, particularly Westinghouse, the lubricating system is attached to the gear sets and pumps, which are of spur gear type, are driven from the high speed pinion shafts by means of spiral gears. Other systems, and thus far all United States naval installations, are independent steam driven lubricating pumps. In some cases, the oil system for the gear sets is independent of the system for the turbine bearings and thrusts; in others there is only one system for both gears and other bearings.

From the point of view of securing the most satisfactory lubricating system for both gears and bearings, separate systems are better, but from the point of simplicity a combined system is to be recommended. For large installations, separate lubricating systems with separate coolers appear to be justified. In such cases the oil and oil pressure most suitable for the gears can be used, and also that which best suits the bearings. Where there is only one system, a compromise between the bearings and the gears has to be reached; furthermore, if the lubricating system for the gears is separate, there is less chance of water, lint or pieces of metal getting into the oil from the gears. Of course there is a little more to look out for.

In general, independent instead of attached oil pumps are preferred, because then a better regulation of the supply of oil is possible and adjustments can be made during operation.

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On merchant vessels a gravity system of lubrication is generally employed, there being a supply (also settling) tank located so as to be about twenty feet above the bearings. Oil pumps are provided to pump the oil from the drain tank through oil coolers and filters to the gravity supply tank. Oiling systems employing these features have been elaborately worked out by both the DeLaval and Westinghouse companies for the marine reduction gear sets made by these firms. These systems also have automatic control valves for the oil pumps and automatic by-passes for the filters or strainers, the idea being that the system should be as foolproof as possible and automatically guard against any possible stoppage of oil.

The DeLaval oil purifier or separator for use in connection with marine lubricating systems has recently been introduced. This device is similar to the well-known cream separator. It is piped up to the lubricating drain tank, and by passing the oil through it the oil is thoroughly cleaned of any water, dirt or other foreign material it may contain. This purifier can be operated both when under way or when in port, and by its use the lubricating oil can be kept clean and absolutely clear of water.

POINTS IN OPERATING

The following are some points to be specially noted in connection with handling reduction gears:

Water in the oil is extremely dangerous. A bearing may run with a little water in the oil, but the gear will not. Water in the oil, even if only in minute quantities, is probably responsible for the pitting of the surface of the gears.

The presence of *lint or similar substances* in the oiling system is specially to be guarded against, since it may plug up the oil sprays. Waste should not be used to wipe out the gears or any bearings, and particularly not for cleaning out any of the oil tanks.

The importance of *absolute cleanliness* of the interior of the gear case cannot be exaggerated. All castings in contact with the oil must be thoroughly cleaned to remove all fins, core sand, scale or other foreign matter. No paint, enamel or other coating that may cover up these foreign substances should be permitted.

The greatest possible care must be exercised that any *pieces of gasket* material used in any of the joints in oil piping do not find their way into the oil system. Lubricating pumps should have metallic packing throughout.

A very careful *alinement* and a close and accurate adjustment of the pinion bearings is essential, as any extra back lash will cause trouble. The bearings must be adjusted to bring the pinion in the proper position when it takes the load.

Although great accuracy in adjustment of bearings is essential the pinion bearings must not be set up too tight or the journal will wipe. For a four-inch shaft a clearance of at least eight-thousandths of an inch should be allowed. The reason for this is that the pinion when put under stress will tend to rise up slightly at one end and twist, and if the bearing has enough clearance, this slight skew movement can take place in the oil film, while if it is set up too tightly the journal will wipe at opposite corners.

Wearing of shoulders on teeth of either pinion or wheel —it is important that the engaging wheels have the teeth of same length and accurately adjusted in line. If one is longer than the other, or if they are not in line longitudinally, a circumferential shoulder may be worn on one or the other, which in time will cause trouble and even cause teeth to cut and break. To avoid this, the ends of the teeth should be chamfered off, and when any signs of a shoulder appear it should be scraped out and the edge making it cut away.

A common source of trouble in operating reduction gears is scoring of the gears, due to defective lubrication or the presence of some piece of metal. In such cases the scored surfaces should be carefully cleaned out and smoothed up. In well cut and well lubricated gears the wear is very slight, though in the course of five or six years the wear on the pinion teeth may be sufficient to require the installation of a new pinion. In installing reduction gears, the gear wheel should be lined up with the tail shaft. The pinion bearings, usually three, must be parallel, both in a vertical and in a horizontal plane, to the journals of the gear wheel. The position of the tooth mesh largely affects the smooth operation. As a rule, the clearance at the root of the thread should not be large and the adjustment should be such that there is plenty of room for the oil film and very little more. The clearance on the sides of the teeth must be sufficient to allow for any expansion as the gear heats up, and sufficient for an oil film under any conditions.

NOISY GEARS

The cause of noisy gears is, of course, some slight inaccuracy in the cutting of the teeth or in the adjustment or fitting of the parts. This initial sound may be intensified or deadened by various surrounding conditions, such as the resonance of the gear spider or gear cover and casting, so a rather noisy gear may otherwise operate quite satisfactorily. The presence of objectionable noise is, however, an indication of some inaccurate work or adjustment. Lack of static or dynamic balance of either gear wheel or pinion may intensify the noise and may even cause certain deflections which may be responsible for it. Frequently a noisy gear can be improved by substituting another pinion. The shape of the cover over the gear case, its supports and the material it is made of may add to or subtract from the noise. Sheet metal acts more as a sounding board than does a cast iron cover. Changing the mesh of the teeth so that they mesh closer may sometimes reduce the noise. Of course, one of the first things in the elimination of noise is to check up on the alinement. The alinement of the pinion bearings may be thrown out by the bolting up of holding down bolts, hence this should be verified both before and after these bolts are set up.

Gears, after being cut and before being used, should be ground in under load, using an oil bath and ground glass or powdered silicon. This process should continue for a number of hours. It cleans and polishes the contact surfaces and removes any small humps, irregularities or sharp points which might be broken or crushed if the gear were set to work at full load without this grinding process. If there is doubt as to the thoroughness of the grinding process in the shop, the gears may be ground in in the vessel after the installation is complete by having the turbines revolved slowly under steam.

When all other means of reducing noise have been exhausted, a very considerable reduction in its intensity and general objectionability can be secured by fitting sound arresting covers over the surface of the gear case. The cover is made of a heavy layer of cow hair felt, sometimes called acoustic felt, held in place by wood or sheet metal

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lagging. The spider of the gear wheel may also be packed with some sound arresting material to reduce its resonance.

There are also cases where pinions when tried are found to be noisy and on examination show unsatisfactory contact. In such cases pinions have been put through a hobbing machine to skim off any small inaccuracies and then when tried again have shown better contact and operate with less noise. The explanation of this is that certain stresses have been released in the pinions when put under full load, and these have caused very slight local warping. The recutting removes the effect of such warping and any other slight inaccuracies. The pinion after this treatment will probably work satisfactorily.

In the case of Falk gears in destroyers the recutting of pinions after they have been tried under power and found to be noisy has almost invariably reduced noise. In some cases the recutting of the gear wheel has been resorted to before satisfactory operation as to noise was secured. In this case it was thought that the gear wheel had warped due to standing in one position for several months, or else the wheel casting may have been too green when the cutting was done and distorted afterwards. In general, it has been found that noisy gears can be improved by having them recut. It would also appear that the cutting of the teeth should be accomplished in at least two operations, one a heavy rough cut and the other a light finishing cut. This second cutting will be more exact and accurate, as the amount of metal removed is small and there is less tendency for the tool to chatter or tear the metal.

Damage to Gears and Remedies

Repairs to gears are possible at sea. It must not be supposed that some slight accident, due to failure of oil or the presence of some foreign substance in the gear case, will render the gear set useless. A most ordinary case of trouble will be where scoring has occurred due to defective lubrication or the presence of some piece of metal. In such cases the scored surfaces should be carefully cleaned out and smoothed up, using a file scraper carefully and then a carborundum stone. The work must be very carefully done, but some rather rough surfaces can be restored to a satisfactory working condition.

In case some part of a tooth or teeth are bent or dented, it may be possible to remove the hump opposite the dents by scraping, so that the good surfaces of the gear and pinion teeth may continue to mesh properly. If the teeth are damaged or bent to such an extent that scraping will not suffice, the pinion may be removed and the damaged part of the pinion or the part in wake of the damage on the gear wheel can be turned down to below the root of the teeth, smoothed up and then replaced. The gears can then operate at reduced power until a new gear or pinion can be supplied. Thus, a very considerable part of the tooth surface may be damaged and the gear still be made to operate at reduced powers.

Wear

In well cut and well lubricated gears the wear is very slight, though in the course of five or six years the wear on the pinion teeth may be sufficient to require the installation of a new pinion. Spare pinions are kept available for use in such emergency. Gears frequently develop a sharp knife edge caused by a pushing or rubbing over of the metal due to the slight amount of sliding contact. When the knife edge develops, it should be cleaned off by scraping and stoning. The knife edge usually develops during the first few months of service and then the action stops. It should not, therefore, be a great cause for worry.

A certain amount of pitting is sometimes observed on the flanks of the teeth of large gears. Usually this is observed after the first few months of service. The pitting shows itself in minute shallow holes and apparently small flakes of metal break out of the surface, leaving the hollows. This pitting is most prominent in the region of the pitch line where rolling action occurs, but it may be found on any part of the tooth flank. Various causes for this pitting have been assigned. If the surface is not absolutely smooth there may be some high spots or irregularities. When pressure is applied, these minute high spots may be crushed or rubbed off, leaving the depression. A lack of homogeneity where hard and soft spots are formed may also produce a similar action. Particles of water in the oil whereby the oil film is broken in spots and contact of metal produced may also be responsible for some of the pitting that is found.

Corrosion

The teeth and the journals may be rusted and corroded due to the presence of water, either fresh or salt, or to acid in the oils. The gears should not be allowed to stand idle long without examination for rusting. If rusting and corrosion take place, the water or acid should be eliminated at the first opportunity and the surface stoned with an oil stone or fine carborundum stone and the gear teeth cleaned with kerosene (paraffin) to take away any of the grit and to cut out any heavy particles of oil and rust that may be in out-of-the-way places. One of the serious dangers caused by corrosion on the gears is that flakes of rust fall off and get into the lubricating system. Rust may also form on the inside of the casing and gear cover and the flakes may become objectionable. No definite coating, other than zinc paint, to prevent this rusting is as yet known to the operating service. Keeping water out of the oil is, of course, the most effective way of arresting any rust inside of the gear casing.

Points in Alinement

The gear wheel should be lined up with the tail shaft. This fixes the position of the gear case. The pinion bearings, usually three, must be parallel both in a vertical and in a horizontal plane to the journals of the gear wheel. They are usually bored out in a machine that will give such alinement, but fitting may be necessary, and, in any case, they should be checked after installation in the vessel.

The lower pinion bearings being bedded in and in alinement with themselves and with the gear wheel, the cap brasses can be fitted and adjusted to a uniform lead. A clearance of .002 inch per inch of diameter is permissible and leads should not vary more than .002 inch. In the usual two pinion gear the caps take the load on one side, and if the lower bearings are in line and the leads uniform, the caps must also be in line.

The position of the tooth mesh is another point that largely affects the smooth operation. Logically, the gears should come in contact on their pitch circle, but due to slight variations in the cutting or modified position, due to running pressures and the nature of oil film, a contact slightly off from pitch circle may improve operation. As a rule, the clearance at the root of the thread should not be large and the adjustment should be such that there is plenty of room for the oil film and very little more.

The clearance on the sides of the teeth must in any case be sufficient to allow for any expansion as the gear heats up, and enough for an oil film under any conditions. This clearance should not be less than five-thousandths of an inch, while it seems to be inadvisable to have more than

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fifteen-thousandths of an inch even on large gears. This clearance can be adjusted by moving the pinion in or out. A too great clearance seems to increase the intensity of the noise made by the gear. Some gears, however, run quite satisfactorily with a clearance of tweny-five-thousandths or even more. Note should be taken of the fact that the gears when under load may develop a fairly high working heat. The temperatures may vary from 110 to 180 degrees F., hence these temperatures should be allowed for in lining up and making adjustments.

KINGSBURY THRUSTS

Kingsbury thrusts are now usually installed in connection with marine turbo-gear sets, both as thrusts on the turbines and on the reduction gear sets. The detailed mechanism of these thrust bearings is given in pamphlets issued by the manufacturer, Albert Kingsbury, Pittsburgh, Pa. These thrusts work very well when properly lubricated, but a failure of the oil, even for a short time, will cause the bearing shoes to burn out. As soon as any heating is discovered, the engines should be slowed until the normal supply of proper lubricant is again present.

Special information concerning the operation of reduction gears made in the United States can be found in the following:

Pamphlet, DeLaval Steam Turbine Company, Trenton, N. J., marine reduction gears and oiling system for same.

Pamphlets issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and the Falk Company, Milwaukee, Wis.

> The presence of objectionable noise in reduction gears is an indication of some slight inaccuracy in the cutting of the teeth or in the adjustment or fitting of the parts Frequently a noisy gear can be improved by substituting another pinion. The noise may be increased or diminished by the shape of the cover over the gear case, its supports and the material it is made of. Changing the mesh of the teeth so that they mesh closely may sometimes reduce the noise, but the first precaution in the elimination of noise is to check up the alinement. When all other means of reducing noise have been exhausted, a very considerable reduction in its intensity can be secured by fitting sound arresting covers over the surface of the gear case. In general, it has been found that noisy gears can be improved by having them re-cut.

INSTANCES OF GEAR TROUBLE

The following are some tabulated instances of gear trouble. Notes *A-G* are taken from the paper "Progress in Turbine Ship Propulsion," read before the Society of Naval Architects and Marine Engineers in 1918 by Francis Hodgkinson, of the Westinghouse Electric & Manufacturing Company.

Note A: U. S. S. *Neptune*. This ship was equipped with two sets (twin screws) single reduction gears and turbines, the turbines having been largely experimental and were not successful. The gears, however, operated splendidly. The turbine machinery was then replaced, and inasmuch as a higher turbine speed was considered desirable, new gears involving a greater speed reduction were also installed at this time. The designed constants of the new gears were very high and are still much in advance of our present practice.

Considerable trouble was experienced due to the teeth abrading, which was only overcome by the use of lard oil. Since that time, however, in November, 1915, no further trouble has been recorded, and the teeth at the last inspection were in good condition without any indication of wear.

Note B: S. S. *Maui*. This vessel was built by the Union Iron Works. Inasmuch as we were late in delivering the machinery, we were unable to carry out any tests on the gears in the works, and inasmuch as great store was set by the owners that nothing should go wrong on the maiden voyage, and as there was some uncertainty as to the excellence of the tooth surface, lard oil was employed as a lubricant for the first two voyages, after which mineral oil was substituted for the lard oil.

The operation of the machinery was all that could be desired for eight voyages, at which time there was abrasion of the gears due to failure of the lubrication. This was discovered in Honolulu and the ship returned to San Francisco with nothing being done to the machinery except an attempt to clean the oiling system. The tooth surfaces smoothed up considerably during the voyage.

The gears were then transposed from one side to the other in order to make what had been the astern surfaces the ahead surfaces, so as to use uninjured tooth surfaces for ahead operation.

Again, because of some uncertainty of the tooth surfaces, lard oil was employed as a lubricant and the vessel entered in government service, going to Chile for cargo and proceeding to Baltimore. During the voyage there was an accident to an oil cooler, admitting salt water to the system. The shipbuilder having provided no means of removing any water, the effect of the salt water on the lard oil was to turn it violently acid, which necessitated a complete overhauling of the machinery on its arrival in Baltimore.

On this being completed and on the trip from Baltimore to New York, trouble was experienced with abrasion of the tooth surfaces, due, it was believed, to an inferior quality of oil, together with further failure of the oil cooler, admitting enough water to the system to make an emulsion of approximately 30 percent. A better oil was substituted and nothing was done to the tooth surfaces, the vessel having made one voyage to Europe and back with no trouble so far as the gears are concerned.

During this voyage trouble was experienced with one of the turbines, causing an extensive repair because of an obstruction in one of the oil passages to the thrust bearing of the turbine, causing the thrust bearing to fail; the turbine rotor, moving endwise, completely wrecking the labyrinth packing between the ahead and astern elements and buckling the rotor.

Note C: S. S. *Golaa*. Norwegian oil tanker built by the Chester Shipbuilding Company and chartered by the British Admiralty. Put in service July 6, 1917. Made three round trips to English ports. At present in coastwise trade between Port Arthur, Tex., and Philadelphia or Bayonne. Towards the end of the last trip from Europe (February, 1918) some teeth on the starboard high speed pinion broke out. This gear was disconnected and the ship made port, using the low pressure turbine only. Inspection showed a break occurred on one helix, 3 inches from the end of the tooth face. There was no evidence of wear on any of the tooth faces, the undamaged portion of the broken tooth face indicating uniform distribution of load. This fact and the position of the fracture make certain that the accident was due to defective material.

In August of this year the high pressure turbine suf-

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fered injury as a result of improper setting of the turbine thrust bearing. Shortly thereafter an accident occurred to the pinion which replaced the one originally defective. The character of the broken tooth was similar to the previous one. The broken parts have not yet been received to enable a careful examination of the material to be made.

Note D: S. S. *Sudbury.* An American freighter built by the Chester Shipbuilding Company for the Shawmut Steamship Company. It is at present being operated by the U. S. Naval Overseas Transportation Service. A few days after leaving France on the return half of her maiden voyage some teeth broke out of the starboard high speed pinion. This gear was disconnected and the ship returned to New York, using the low pressure turbine only, with which 9 knots was attained, the designed full speed being 10½ knots.

On arrival at port, inspection showed no wear, the tooth load having been well distributed on all tooth faces. Several teeth were cracked. Subsequent examination of the steel indicates defective material, most probably due to faulty heat treatment, the fracture indicating the steel had been burned. This was confirmed by discovery that some teeth in the port high speed pinion were also cracked, although no failure occurred in service. Both pinions were forged from the same billet and treated at the same time. These pinions are similar as to material and design with twenty-five other pinions now in successful operation.

Note E: S. S. *Avondale.* An American oil tanker, built by the Chester Shipbuilding Company and being operated by the Pan-American Oil Company for the United States Shipping Board. Just as the ship was leaving Philadelphia for her trial trip a heavy blade rub was heard in the high pressure turbine. Inspection indicated defective workmanship. Some of the rotating blades were loose as a result of having been improperly put in. The spindle was rebladed and the ship proceeded satisfactorily from Philadelphia to New York. This turbine is a counterpart of twelve others now in successful operation on various ships.

Note F: S. S. *West Ford.* This vessel left Seattle at 5 P. M. on July 14, 1918, on her maiden voyage to an Atlantic port. Seven hours out from Seattle oil commenced foaming out from the turbine, running over the engine room gratings. The chief engineer was called out, and instead of investigating the reason for augmentation of the oil, he was content to pump 200 gallons to a reserve tank. Later the same thing occurred, oil again running out on the grating, and later still, at 2:14 A. M., the high pressure turbine commenced vibrating so badly that it interfered with their lighting system. They shut down to remedy the matter of the lighting system, and on trying to start the turbine it required 125 pounds initial pressure to revolve it. Serious vibration was again in evidence, so the chief decided to do what he termed "crank up on the thrust." It was impracticable to anchor, so they returned to Port Townsend at 40 revolutions per minute. They then made an observation of the oil in the drain tank, and on removing the cap the oil squirted to the roof of the shaft alley. It was later discovered that an oil cooler tube had split, admitting large quantities of salt water to the oil system.

Instructions had been given that the level of the oil in the drain tank should be regularly observed, and it is incomprehensible that it was not at once obvious that something was getting in the oil system from some exterior source. Merely looking at the oil would have determined this was salt water. Then all that would have been necessary was to shut off the water service to the cooler and separate the relatively small quantity of salt water from the gravity tank, and there need have been no interruption whatsoever. The result of such neglect was for the bearings, for want of lubrication, to let the rotor down, causing considerable injury to the turbine.

Note G: U. S. S. *Arizona.* On a voyage from Cuba to the United States the teeth of one of the cruising gears scored. Subsequent investigation showed that the oil pumps had stopped and the supply to the gears had failed. The teeth were dressed up and no further trouble has been experienced.

Miscellaneous Mishaps

U. S. S. *Salem.* Fitted with General Electric (Alquist laminated) gear. After several months in successful operation a tooth on one pinion broke off. Got into mesh and cut up pinions and gear so that gear set could not be operated. New gears had to be cut. Damage apparently due to uneven wear, so that one lamination took excessive load and finally broke a tooth.

U. S. S. *Meredith.* Falk gears. A piece of hard steel about ¼ inch diameter and 8 inches long, left in gear case, was caught at the edge of the pinion and broken up. Made numerous bad dents on pinions and some on gear wheel. Presence of obstruction not discovered while in operation, but found on post trial examination. Dents and scratches were cleaned and stoned and gear has continued to operate successfully.

Luckenbach vessel equipped with laminated gears, General Electric design, double reduction; shortly after being put in service a piece of tooth broke off and cut up gear. Casualty probably hastened, due to failure on part of personnel to see that the gear received a proper amount of oil.

Katrina Luckenbach and *F. J. Luckenbach.* Gears similar to General Electric design as above, but not built by that company, double reduction. High speed pinions wore very badly, due probably to lack of oil at some time. The trouble with these gears is probably that after wear was taking place, due to some inaccuracy in cutting or lack of oil, the pinions were shifted with reference to the teeth of gear wheel, and in the new position the teeth did not mesh properly and then began cutting. It has been found that in double reduction sets of this design a proper mesh is only obtained when the pinion is engaged in certain definite positions and that when the pinion is revolved so as to change the teeth that are engaged an improper meshing results and the teeth of the pinion wear away.

New Vessel from Middlesborough

THE steel screw, shelter deck steamer *Princess Olga,* built by Sir Raylton Dixon & Company, Limited, at their Cleveland Dockyard, Middlesborough on Tees, under British Corporation survey, for Messrs. M. Langlands & Sons, Ltd., Glasgow, Liverpool, etc., for their extensive coastal service, recently underwent satisfactory trials and was delivered to the owners. The principal dimensions of the vessel are: Length, 250 feet 6 inches; beam, 35 feet; depth, molded, 17 feet.

The steamer has two holds served by three hatches equipped with nine steam winches. Water ballast is carried in the double bottom, extending all fore and aft, and in the fore and aft peaks as well as in a deep tank forward.

Propulsion is by a triple expansion engine with cylinders 19 inches, 31 inches and 52 inches diameter by 36 inches stroke, supplied with steam at 200 pounds per square inch pressure by two large single ended boilers, fitted by Messrs. Richardsons, Westgarth & Company, Ltd., Middlesborough.

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Design of Main Exhaust Pipes for Turbines

BY CYRUS HANKINS*

With the increased use of the turbine in ship propulsion, there is no part of the power equipment that should be given more careful consideration than the condenser, its connections and its auxiliaries. Although in most installations the turbine condenser and other auxiliaries are built by companies other than the shipbuilder, it usually falls to the lot of the shipbuilder to supply the exhaust pipe from the turbine to the condenser. It is the object of this article, therefore, to present some definite information on the design, manufacture and requirements of turbine exhaust pipes in general, which may be of assistance to the engineer responsible for the design of these parts.

THE material of exhaust pipes is either cast iron or steel plates and shapes. These two types may be again divided into exhaust pipes with and without expansion joints. Exhaust pipes of both cast iron and steel are required to be fitted by some turbine manufacturers with an expansion joint somewhere between the turbine and condenser, preferably adjacent to the turbine. The need of an expansion joint of this type is doubted by some engineers, but with a cast iron exhaust pipe it at least removes any element of doubt as to its need. For built-up steel exhaust pipes there are many successful installations without expansion joint, and unless the exhaust pipe is long and straight, which is exceedingly uncommon, there can be no need of fitting an expansion joint. When the turbines are compounded and the intermediate pipe between the two turbines might set up detrimental stresses from expansion, then it will always be safe to fit an expansion joint of some approved type.

Expansion Joints

The expansion joint when fitted in the exhaust pipe from the turbine to the condenser is usually similar to that shown in Fig. 1. The exhaust pipe (1) is made with a flange at the bottom, either internal or external. This flange is machined on the surface in contact with the copper bellows (2). If the exhaust pipe is structural, then this flange is made from an angle or is cast steel.

The cast iron ring pieces (3) are usually made in the following manner. Rings with the desired radius r and the proper cross-section are machined on all contacting surfaces, then cut diametrically with some definite loss, usually ¼ inch. Straight side pieces of the same cross-section are machined on the same contacting surfaces as the rings, and when finished to the desired length are fitted between the two semicircles. This form makes a readily adaptable shape for both the turbine exhaust casing opening and the expansion joint.

The copper bellows (3) is made up with the desired radii for all curves. The thickness of the copper used can be safely taken as about No. 8 B. W. G. for an expansion joint about 3 feet by 2 feet and increasing or decreasing in thickness proportionally for other sizes.

The flange of the exhaust opening in the exhaust casing (4) is machined in a manner similar to the flange of the exhaust pipe. The end flange of the exhaust pipe, the ring pieces and the flange of the exhaust casing are all drilled for bolts, or drilled and tapped for studs, the spacing of these bolts or studs being such as will insure a tightly compressed joint on the copper bellows. Bolts (5) for supporting the weight of the exhaust pipe are fitted on opposite sides or ends of the expansion joint. These bolts must be sufficiently flexible and have enough clearance in the holes through which they pass in the exhaust pipe flange to allow for any lateral movement resulting from expansion. The nuts on the upper ends of these bolts are so fitted as to leave about ⅛ inch clearance, which provides for a certain amount of expansion tending to lift the exhaust pipe away from the turbine casing.

Expansion joints essentially as above outlined seem to meet all needs. The question, however, of fitting an expansion joint should be decided by the requirements imposed by the turbine manufacturer and the judgment of the engineer in charge of the design of the propelling machinery arrangement.

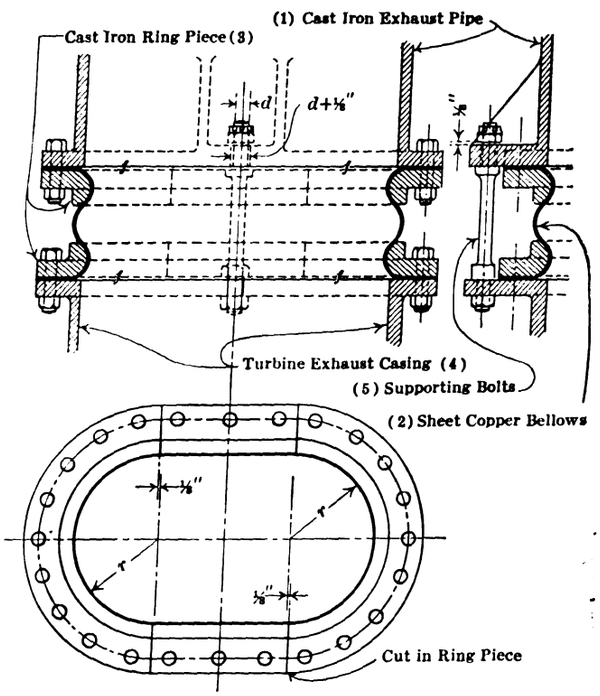

Fig. 1.—Expansion Joint

Cast Iron Exhaust Pipes

Two typical cast iron exhaust pipes are illustrated in Figs. 2 and 3. The type shown in Fig. 2 is made in two pieces in order that the castings may be more easily handled in the foundry. The external ribbing shown may be adapted to a one-piece pipe as well. The test pressure usually applied to exhaust pipes is an internal hydraulic pressure of from 20 to 30 pounds per square inch, which test pressure, being applied internally, creates stresses the reverse of those set up under working conditions. The working pressure is usually assumed for the purpose of

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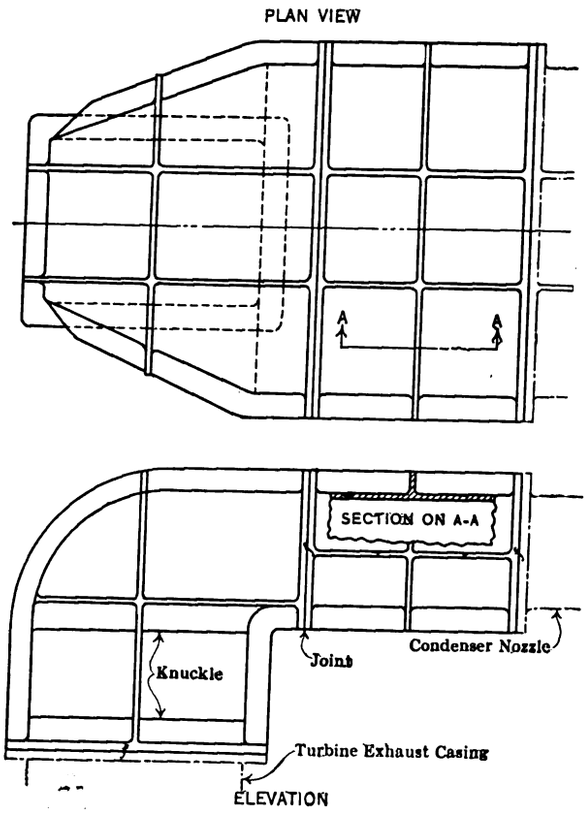

Fig. 2.—Two-Piece Cast Iron Exhaust Pipe

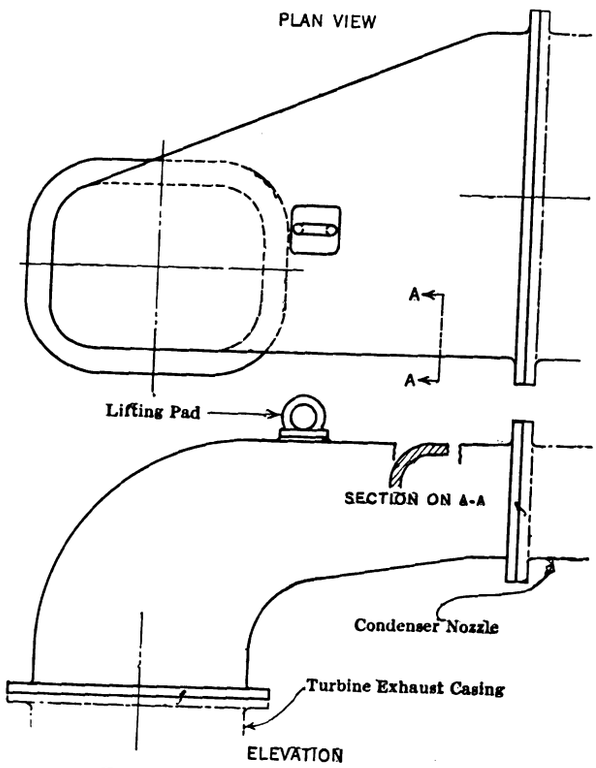

Fig. 3.—One-Piece Cast Iron Exhaust Pipe

design as an external pressure of 15 pounds per square inch.

The ribbing with a section of the plate equal to the pitch of the ribs on a pipe of the design of Fig. 2, may be taken as a beam with a length equal to the distance between supports. The section modulus of such a beam should be figured and the stresses in tension or compression in the extreme fibers found. These stresses will be those created by a load of the specified test or working pressure, figured as an internal or external pressure, as the case may be. The tensile stress under test will come at the outer edge of the ribs, and care must be taken in the inspection of the casting to see that this stress will not be localized by any defect, such as that resulting from floating sand or similar cause. In this design the stress in tension may be safely run as high as 5,000 pounds per square inch. Under the working pressure the outer edge of the ribbing becomes a compression member and the inner surface the tension member. Under these conditions the compression side will show the higher stress, and this may safely run to 7,500 pounds per square inch. Cast iron exhaust pipes should be cast in well-surfaced molds and the castings thoroughly cleaned inside and out and carefully painted, as even the best cast iron is porous to a certain degree, and any avoidable leakage under vacuum is exceedingly detrimental to high efficiency.

STEEL EXHAUST PIPES

The type of exhaust pipe shown in Fig. 3 has no ribbing or other stiffening, depending only on the thickness of the metal and the large curved surfaces to take the load. This design simplifies the pattern and foundry work, but is necessarily quite heavy.

Steel exhaust pipes have been the choice of most engi-

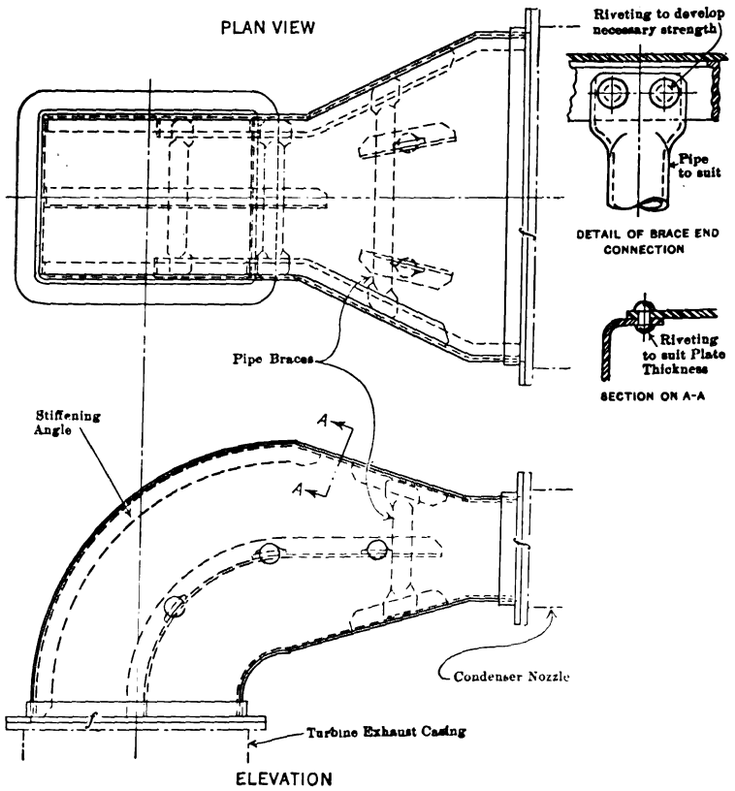

Fig. 4.—Steel Exhaust Pipe

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Fig. 6.—Group of Structural Exhaust Pipes

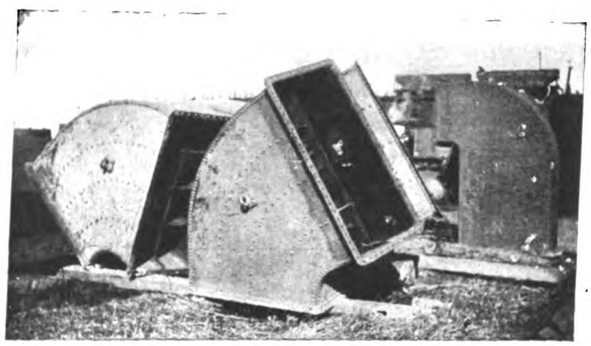

Fig. 8.—Exhaust Pipes with Perforated Plates for Internal Bracing

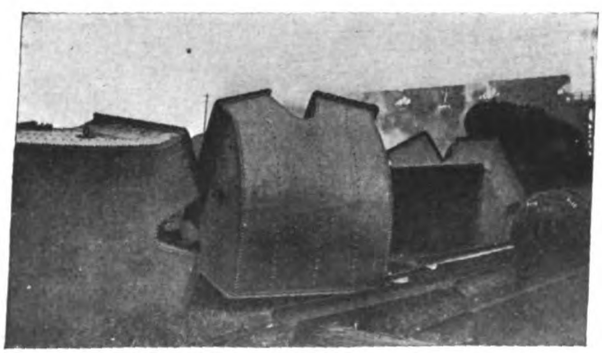

Fig. 7.—Sections of Exhaust Pipes for Double Flow Turbines

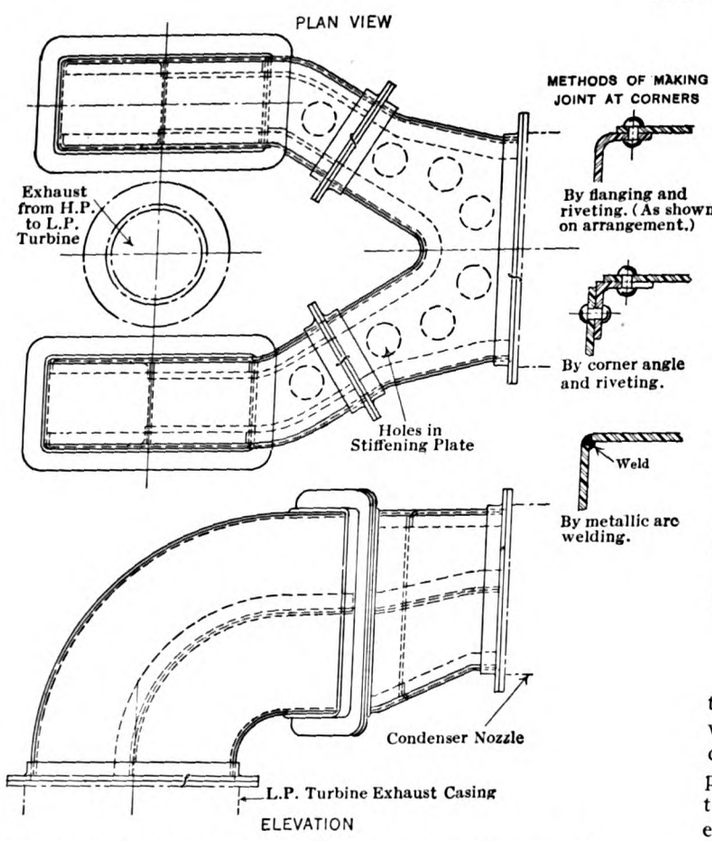

Fig. 5.—Steel Exhaust Pipe for Double Flow Low Pressure Turbine

neers and they usually make an exceedingly satisfactory and relatively light job. Exhaust pipes of this class vary in detail of design. Two examples of widely different types are shown in Figs. 4 and 5. Fig. 4 is a typical arrangement for a merchant ship and lends itself well to quantity production. This type necessitates only getting out templates and possibly a few forming blocks, but usually the design can be so handled as to require very little furnace work. Fig. 5 is the usual arrangement with a high and low pressure turbine installation, where the low pressure turbine is of the double flow type with two exhaust openings. The construction of these pipes follows the same shop practice as those of Fig. 4.

The test and working pressures of pipes of either design, Figs. 4 or 5, may be taken the same as for cast iron pipes and the stress calculations do not differ essentially. Struts or tension members, depending on the application of the load, are usually fitted at figured intervals on the interior of the pipe. These struts may take the form of plates running in the direction of the steam flow and may be attached to the shell by continuous angles. These plates are sometimes perforated with holes from 3 inches to 9 inches diameter to permit of perfect pressure equalization. The more common form of internal bracing for ordinary construction, however, is to use continuous angles or short angle clips running in the direction of the steam flow and attached to the inside of the pipe from which connection is made, from side to side of the exhaust pipe at the proper figured intervals, by struts of standard or extra heavy pipe. The pipe for these struts is flattened at the ends and riveted to the continuous angles or clips.

Some builders consider it good practice to use also external bracing, usually in the form of angles or bulb angles. These are arranged to run transversely to the interior angles, thereby dividing the surface of the plates into squares. The fitting of external bracing can usually be avoided by a careful study of the design and should be done, if possible, as it materially complicates the fabrication and increases the chances for leakage.

Stress Calculations for Flat Plates

The stress calculation for flat plates is a study to which many engineers have devoted much time with only limited success. Except in certain cases the methods used can be applied only approximately to the design of such irregular structures as exhaust pipes. To treat a 1-inch wide element of flat steel plate as a simple or fixed beam between definite supports, such as a corner

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or longitudinal angles, will result in an apparently very high stress, which is not borne out by tests. For an exhaust pipe made of ¼-inch steel plate and fitted only on the inside with longitudinal stiffening angles, these angles being properly tied to corresponding angles on the opposite sides of the pipe, these longitudinal angles may be safely spaced 18 inches apart. A pipe thus made will stand safely an internal test pressure of 30 pounds per square inch. Curved or otherwise distorted plates will, by reason of their shape, require less support than flat plates, but the extent to which advantage can be taken of this may be best judged from the design as developed.

The end flanges of a steel exhaust pipe are usually made from a rather heavy angle, about 4 inches by 3 inches by ½ inch, or such a size as will correspond or connect satisfactorily to the turbine or condenser connecting flange. Sometimes these end flanges are left unattached until the turbine and condenser are located in the ship and are then riveted up to suit the work as found in the ship. This practice, however, prevents testing the exhaust pipe until a very late date, so the best results can usually be had by setting the condenser on its foundation, located to a template taken from the finished exhaust pipe or made to the designed dimensions of same.

Figs. 6, 7 and 8 are photographs of sections of pipes similar to those in Fig. 5. These pipes are all made from ¼-inch steel plate with corner angles 2½ inches by 2½ inches by ¼ inch, and stiffening angles 2 inches by 2 inches by ¼ inch, stayed with 3/16-inch plates perforated with 9-inch diameter holes in the straight portions only. The stiffening angles and stay plates in these pipes are from 16 inches to 18 inches pitch and, as will be noted, there are no transverse stiffeners on the outside of the pipes.

Lifting gear connections should be provided on all sections of exhaust pipes. While such provisions are not essential it makes it easier and safer in overhauling the turbine. For this purpose pad eyes or similar devices may be riveted on approximately in line with the center of gravity.

Fitting the Exhaust Pipes

In making up the joints of the exhaust pipe to the condenser and the turbine in the ship, great care should be exercised to insure the flanges coming squarely together. The connecting bolts should be of ample number and size to make it certain that the flanges can be drawn tightly together. A good quality composition or rubber gasket, about 1/16 inch, should be used in all joints. After installation, exhaust pipes should be carefully painted and all joint flanges, bolts, nuts and gasket edges shallaced. It must always be borne in mind that even the smallest air leak results in a reduced vacuum and a lowering of efficiency.

In the design and manufacture of exhaust pipes the shipbuilder has a good opportunity, with a little care in design, to effect a saving in manufacturing and installation costs, and, without doubt, in many cases quite a saving in the operating costs for the life of the ship.

European Motorship Building

BY OUR SPECIAL LONDON CORRESPONDENT

AN immense amount of interest was taken last year in the details which were published regarding the novel type of internal combustion engine known as the Still motor, which is virtually a combination of a steam and an oil engine, acting as an internal combustion engine above the piston and a steam engine below the piston, the two operations taking place in one cylinder. It will be remembered that the inventor claimed an efficiency some 30 percent higher than that possible in an ordinary Diesel engine, and his claims appear to have been borne out by the prolonged tests which were effected.

Clyde Yard to Build Still Engine

One of the best known shipbuilding firms on the Clyde, the Scott Shipbuilding and Engineering Company, took out a license for the construction of this motor and a unit of one cylinder has now been built which will be thoroughly tested out. If the results achieved are completely successful, standard six cylinder engines will be built immediately for installation in large cargo vessels. The cylinder which is now undergoing trials has a diameter of 22 inches, a stroke of 36 inches and operates on the two cycle principle developing 400 brake horsepower at 120 revolutions per minute. The type of motor that will first be standardized is a six cylinder set with cylinders of these dimensions developing 2,400 brake horsepower in one unit. Both engineers and shipbuilders are watching the experiment with the greatest interest, and while some shipowners are inclined to think that the employment of steam in combination with the oil engine is a retrograde movement, the opinion is held in many circles that this is in fact an advantage, since steam may profitably be used on a motorship for driving the auxiliary plant. It would seem, however, that the first cost of the machinery would be greater than that of ordinary Diesel engines, but upon this point it is impossible yet to express any final opinion.

British Shipowners Contracting for Motorships

Orders continue to be placed on a large scale by the leading shipowners in Great Britain for motor vessels, mainly for the cargo carrying trade, and among the more important concerns which have recently adopted this policy are the Royal Mail Steam Packet Company, which has contracted for three 8,000-ton motor vessels with Workman Clark and Company, of Belfast, and The Pacific Steam Navigation Company, which has ordered a motor vessel of approximately the same size from Harland and Wolff. In all these vessels four cycle machinery of Harland and Wolff construction will be installed, and this firm, in order to cope with the vast amount of work in hand, has recently purchased a very big munition works in Glasgow to add to its already extensive factory designed and built purely for Diesel engine construction. It is hoped that when these extensions are in working order the machinery for about 40 motorships will be turned out annually.

New Bibby Motor Liner

The Bibby Line, one of the largest shipowning firms trading to the East, has ordered a second motorship similar to the vessel referred to recently in these notes, and the two sister ships will both be in commission within the course of the next few months. These vessels are inter-

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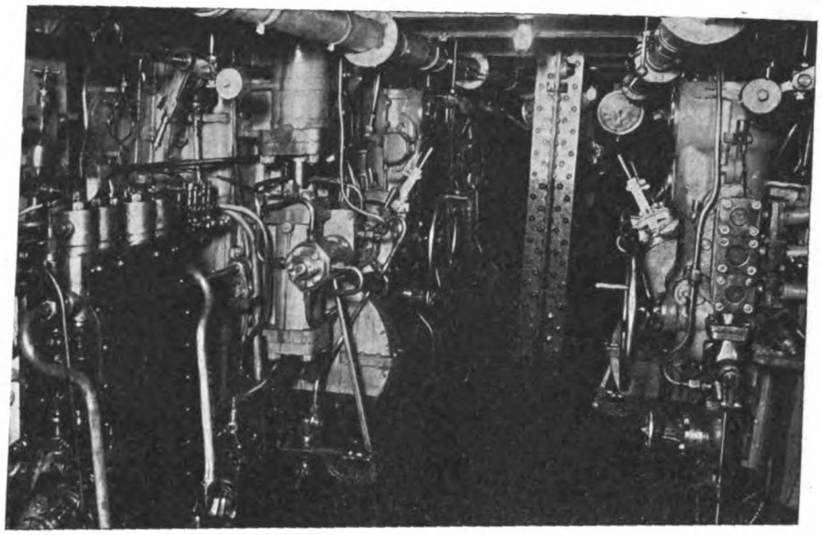
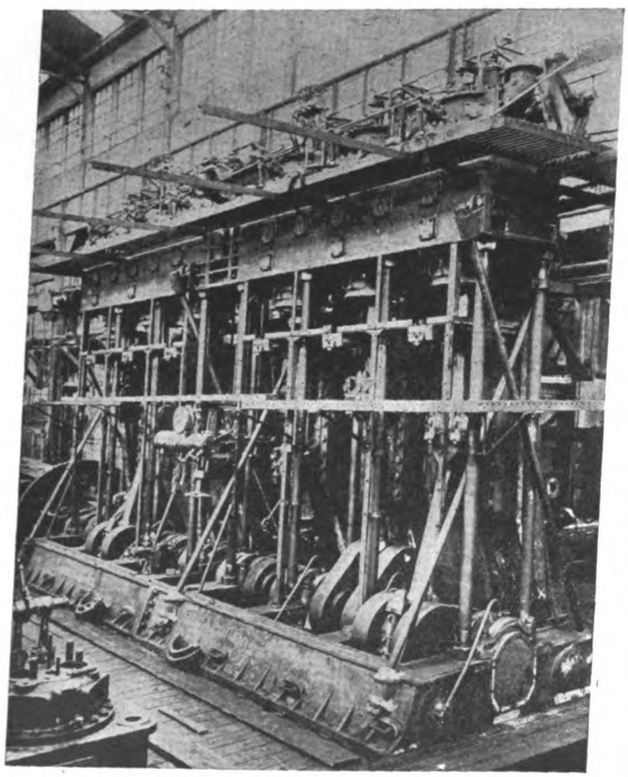
esting, as they are of approximately the same size as the 13,000-ton motorships built for the United States Shipping Board. They are 450 feet in length, with a beam of 57 feet, and carry rather more than 12,000 tons. The machinery is of exactly the same power as that installed in the United States Shipping Board vessel, comprising a couple of six cylinder engines developing 2,250 indicated horsepower, each at 115 revolutions per minute, with cylinder dimensions 740 millimeters bore and 1,150 millimeters stroke.

It appears that this class of vessel and engine is likely to become standard, as a large number of similar ships have recently been ordered by Continental shipowners for construction in Copenhagen by Burmeister and Wain. As in many of the latest vessels, electrical auxiliaries are employed throughout and the system adopted is interesting, comprising the installation of three 100-kilowatt Diesel driven electric generators. Bilge pumps, circulating water pumps, lubricating oil pumps, steering gear, winches and, in fact, every auxiliary on the ship is electrically operated, the only steam plant being a small auxiliary compressor to be employed in emergency. The boiler supplying the steam to this compressor is moreover utilized for heating the cabin, but for no other purpose.



Control Platform in the Engine Room of the New 10,000-Ton Motor Tanker *Narragansett*, Built by Vickers, Ltd., for the Anglo American Oil Company

Another motor vessel has just been completed in Holland for the Otto Thoresen Line named the *San Miguel*. This ship is of relatively small size, but is of interest from the fact that she is a single screw vessel, giving an indication of an increasing confidence felt by shipowners in the reliability of oil engines for ship propulsion. The motor, of which an illustration is given, has six cylinders and develops 1,400 indicated horsepower at 125 revolutions per minute, the cylinders being 560 millimeters bore and 1,000 millimeters stroke. It will be noticed that there are some points in difference between this motor and the type developed by the American licensees of the Werkspoor Company, of Amsterdam, who built the engine. The main feature of the motor is the method of supporting the cylinders by means of long steel columns with cross bracing, the cylinders being arranged in blocks of three, enclosed in each case by one water jacket. This engine is extremely popular with shipowners and there are about one dozen motorships now under construction in which Werkspoor motors ranging from 1,100 to 1,800 indicated horsepower are to be installed.



1,400 Indicated Horsepower Werkspoor Engine Installed in the Single Screw Motorship *San Miguel*

STANDARDIZED MOTORSHIPS FAVORED

The idea of standardization in motorship building has gained a great hold on European shipowners, and nearly all the leading motorship builders in Great Britain and on the Continent have orders for half a dozen motorships of exactly similar size and similar machinery. Messrs. Vickers, Ltd., of Barrow, for instance, have received contracts for six 10,000-ton motor tankers, of which the first, the *Narragansett*, recently started on her maiden voyage to New Orleans. As might be anticipated, the Vickers system of solid injection of fuel is employed in the machinery, which comprises two sets of 1,250 brake horsepower engines in each ship. They are of the ordinary four cycle type with cylinder diameters of 24½ inches and a stroke of 39 inches. Owing to the absence of the air compressor they are relatively short motors with a lower weight and a higher mechanical efficiency than engines adopting the ordinary blast injection system. The fuel is supplied to the fuel valve from four small vertical pumps, which are seen on the left of the illustration showing the control platform of the *Narragansett*. The fuel at a pressure of 4,000 pounds per square inch is taken

(*Concluded on page 602.*)

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The Strainagraph and its Application to Concrete Ships*

BY FRANKLIN R. MC MILLAN†

While this article deals with the measurement of the stresses in the structure of a concrete ship during a launching, it is evident that the strainagraph may be just as efficiently used to determine the stresses in a steel ship not only during a launching but also when the vessel is in a seaway. In fact, Professor McMillan has conducted a test on the steel freighter Westboro while the vessel was crossing the Atlantic in which he obtained a continuous record of the water pressure and resultant stresses in the structure of the vessel by the use of pressure gages and strainagraphs.

THE strainagraph may be said to consist of two essentials, a lever system for multiplying the deformation due to stress and a moving chart upon which the multiplied strains are recorded. In the photographs, Figs. 1 and 2, these main features will be recognized readily. From these views also many of the details of the instrument will be understood.

In Fig. 1 the instrument is shown mounted on a piece of timber; this gives an idea of the general arrangement of a setting. The instrument itself is attached at one

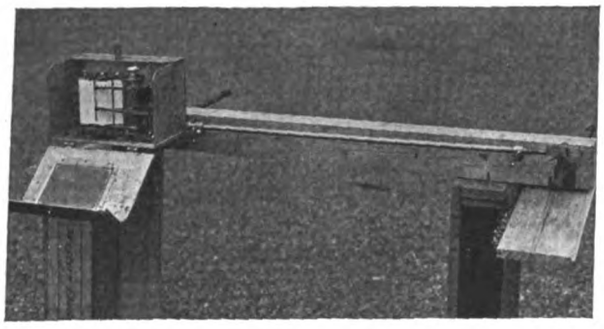

Fig. 1.—The Strainagraph Set Up as it Was on the Concrete Ship

point, and the distance bar or plunger is attached at another. The distance bar is in contact with the lever system, so that any change of length between the points of attachment is transmitted to the lever system and recorded on the chart.

In the larger view of Fig. 2 the details of the lever system can be made out. The large horizontal lever near the base of the instrument is fixed to a shaft, at the circumference of which a knife edge bearing receives the movements from the distance bar. The lever arm here is one-quarter inch, giving a multiplication of nine between this and the large lever. The balance of the multiplication, which is about 140 in all, is made up in the pen arm itself.

The device for receiving the movements from the distance bar cannot be seen in the photograph. This consists of a short plunger carried in a block entirely within the case and bearing against the knife edge mentioned above. The free end of this plunger is turned to a segment of a sphere, so that the distance bar, which has a square end, need not be in perfect alinement to insure proper contact.

It will be observed that the pen arm is pivoted at the extreme right to a movable link and near the center through a short link to a fixed support. This gives a true straight line motion to the marking pen.

Attention is also called to the adjustable counterbalance on the large lever and to the slender coil spring between the right end of the lever and the pen arm. The lever system is perfectly balanced, so that the only resistance to be overcome is the slight friction in the bearings and the small tension in the spring.

The other features of the instrument can be seen in the photographs. The upper pen arm, which is operated by

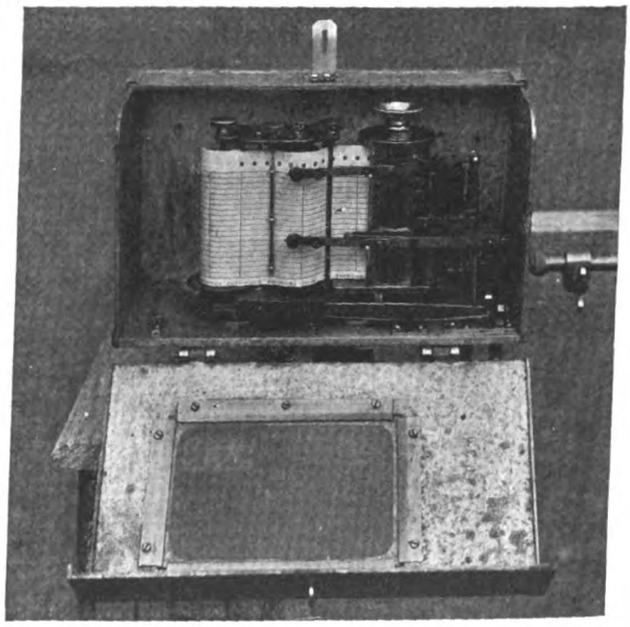

Fig. 2.—The Recording Mechanism of the Strainagraph

the magnet seen at the right, is used to synchronize the records from a number of instruments. The cylindrical piece supporting the magnet and pen also forms the support for the short link of the main pen arm and serves as a container for the feed roll.

The paper is driven by a series of sprocket teeth set in the cylinder upon which the pen points travel. The holes punched in the paper to receive these teeth are clearly seen in both photographs. The re-wind roll at the extreme left is driven by a friction contact, so adjusted that the tension in the paper does not materially change as the spindle is filled.

The photographs in Figs. 1 and 2 were taken before the change was made from a clock to a motor drive for the chart. The clock mechanism is entirely concealed by the

* From a paper read before the American Concrete Institute.

† Formerly research engineer concrete ship division, United States Shipping Board, Emergency Fleet Corporation.

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chart. With the motor drive a train of gears occupies the space at the back of the instrument and to the left of the re-wind spindle. This is driven by a coil spring belt, which passes through the base of the motor suspended below. The instrument, equipped with motor and gear train, weighs 20 pounds, which is a little less than when equipped with the clock movement.

The distance bar is adjustable at both ends, so that it can be accommodated readily to small variations in the gage line. When setting the instrument, the final adjustment is accomplished by the knurled nut at the instrument end, by which the pen can be brought to any position with a slow, steady motion. The fixed end of the distance bar

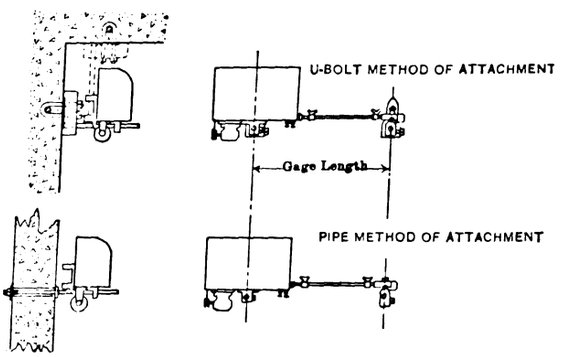

Fig. 3.—Method of Attaching the Strainagraph Used in the Steamship *Atlantus* Launching

is provided with a notch which engages a turned pin, also with a stiff looped spring which holds the pin firmly in the notch. The faces of the notch are tapered so that a width of only one-sixteenth inch bears against the pin; this arrangement permits of some sidewise adjustment for alinement.

The instrument is equipped with a clamp, not visible in the photographs, that grips a bar of ¾-inch diameter in either a vertical or horizontal position. In Fig. 1 the bar, to which the instrument is clamped, is seen projecting back of the timber. The turned pin at the fixed end of the distance bar is screwed into a small casting that grips a similar ¾-inch bar. The small casting is also tapped at the side to receive the turned pin, so that it can be adjusted to a vertical bar.

The device for attaching the instrument to the ship consists of a ¾-inch bar rigidly connected to the concrete. This connection has been accomplished to date by two methods, the U-bolt method and the pipe method, both of which are illustrated in Fig. 3. In the pipe method the ¾-inch bar passes through and is bolted to a pipe sleeve embedded in the concrete, while in the U-bolt method the ¾-inch bar is held by a cast iron wall block, which in turn is clamped to the concrete by the U-bolt itself. The latter is cast in place and is usually clamped around one of the reinforcing bars. The pipe sleeve method is preferable whenever it can be used, as it offers a more simple attachment for the instrument. This method can also be used in attaching an instrument to a structure already completed by simply drilling through the slab or beam. This was done in attaching the strainagraphs to the deck and keelsons of the *Faith*. In this test also a yoke attachment was used on some of the beams, but the other methods are preferable.

It will be observed that in either of these methods the ends of the gage line represent points on two planes, and the recorded movement gives the change in distance between these planes at the line of the plunger.

The motors which drive the record charts were designed to give approximately the same speed of travel to the charts of all the instruments at varying voltages, so that the speed can be varied alike in all the instruments from a central point. They are shunt wound motors operating at all voltages between 10 and 30 and give a speed to the charts varying from 5 to 13 inches per minute. They are connected in parallel to circuits from a storage battery, the voltage being regulated by cutting in the desired number of cells.

Operation of a Series of Instruments

In laying out the circuits on a ship, a system of trunk lines and branches is used, with rather heavy conductors, to avoid a large drop in voltage in the long lines. Care is also taken to have the circuits approximately balanced so that all instruments operate under the same voltage.

The magnets which operate the upper pens of the series of instruments are connected in parrallel to a telegraph relay instrument and a battery circuit. The primary circuit of the relay is connected through a circuit-closing clock, which gives two impulses at each minute and single impulses at each 10-second intervals. These impulses relayed to the instruments give offsets in the continuous line drawn by the magnet pens, from which the record of all the instruments can be compared for any instant of the test. A telegraph key is also connected in the primary circuit, by means of which extra impulses can be introduced to further identify the records or to record special events.

In the launching test of the *Atlantus*, 18 strainagraphs and 14 pressuregraphs were thus operated simultaneously, all controlled from a convenient central point. In the tests on the 8,800-ton steel ship *Westboro* in a recent transatlantic voyage, 23 strainagraphs and 12 pressuregraphs were operating at one time. In these tests over six hundred records were obtained, and throughout the operation was most satisfactory.

Strainagraph Records and Their Interpretation

A sample record from the strainagraph is shown in Fig. 4. This is a portion of a record from the *Faith* taken during a storm. The line drawn by the magnet pen near

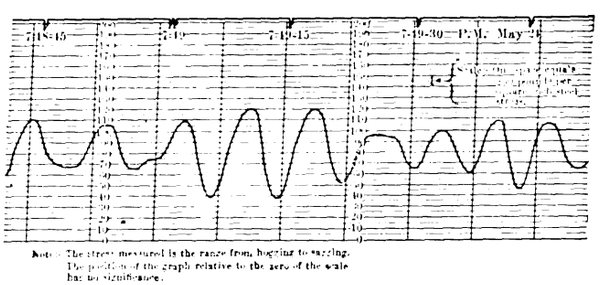

Fig. 4.—Specimen Strainagraph Record Taken on the *Faith* May 24, 1918

Instrument Located Amidships on a Longitudinal Deck Beam About Midway Between Hatches 2 and 3 and on a Line Along the Port Side of These Hatchways. The Pen When Traveling Upward Records Compression; When Traveling Downward Records Extension

the top of the chart will be recognized. It will be noticed that 15 seconds intervals are recorded here. In this test the identifying marks were made by closing the circuit with a telegraph key, as the circuit closing clock was not completed.

The strain record is the wavy line through the central portion of the chart. As noted under the chart, an upward travel of the pen indicates a compression or shortening of the gage length, and a downward travel indicates a tension or a lengthening.

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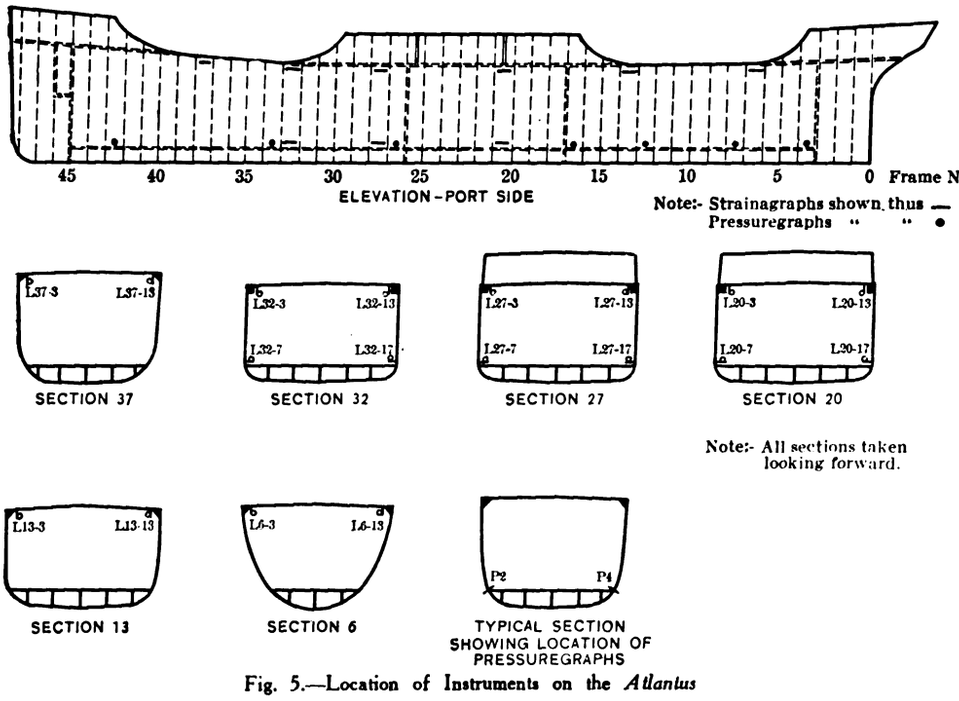

Fig. 5.—Location of Instruments on the *Atlantus*

It should be noted that the scale to which the chart is ruled is unimportant. That this is true will be apparent when it is explained that each instrument must be carefully calibrated, and unless each is provided with a chart of special ruling, a calibration factor or scale unit must be applied in making all reduction of data. The scale unit, therefore, takes care of the scale paper and a chart of any convenient ruling will serve.

On the record shown in the figure, the unit as determined by a calibration is noted. This is given for a 40-gage line and is expressed in terms of pounds per square inch steel stress for each 10 units shown on the printed chart. To obtain the change in stress between any two points, as, for example, for any one second or between any high point and the next low point of the curve, it is only necessary to read the paper scale for the two points and to multiply their difference by the scale unit. For example, the large change from top to bottom at about the quarter-minute point is reduced as follows:

Scale readings 120 and 37: difference = 83.
Stress $83 \times 85 = 7{,}055$ pounds per square inch.

The absence of a zero line for these measurements will have been noted from the foregoing explanation. When an instrument is attached to a ship while in motion, as is the case when shifting instruments from place to place at sea, the pen is constantly in motion and is brought to a central position on the chart before a set of records is started. For a test like the launching, the pen is brought to a convenient position on the chart and the charts run a few minutes before the ship is released. The horizontal line drawn by the pen before the ship is in motion becomes the zero line and its position on the chart can be read from the printed scale. Were it not for errors introduced by temperature changes and the possibility of the instrument being disturbed, it would be possible to attach an instrument to the ship when in quiet water and by a continuous record determine the change from still water to the extreme of a storm. The difficulties mentioned, however, together with the necessity of changing record charts, make this impractical.

Another point in connection with these records should be mentioned here. The recorded movements are deformations and not stresses, but it is found more convenient to express the deformation in terms of equivalent steel stress than in so many millionths of an inch. Thus a deformation in the steel of the magnitude shown by the record would represent a steel stress of a certain amount. For this scale a modulus of elasticity of the steel of 30,000,000 is assumed. For any other value of the modulus the correction can be made easily in the calculations.

CALIBRATION

Calibration of the strainagraphs consists in determining the ratio of multiplication of the lever system. With this ratio and with the scale of the rulings on the paper known, what is called the instrument constant can be determined. The instrument constant is a figure which, when multi-

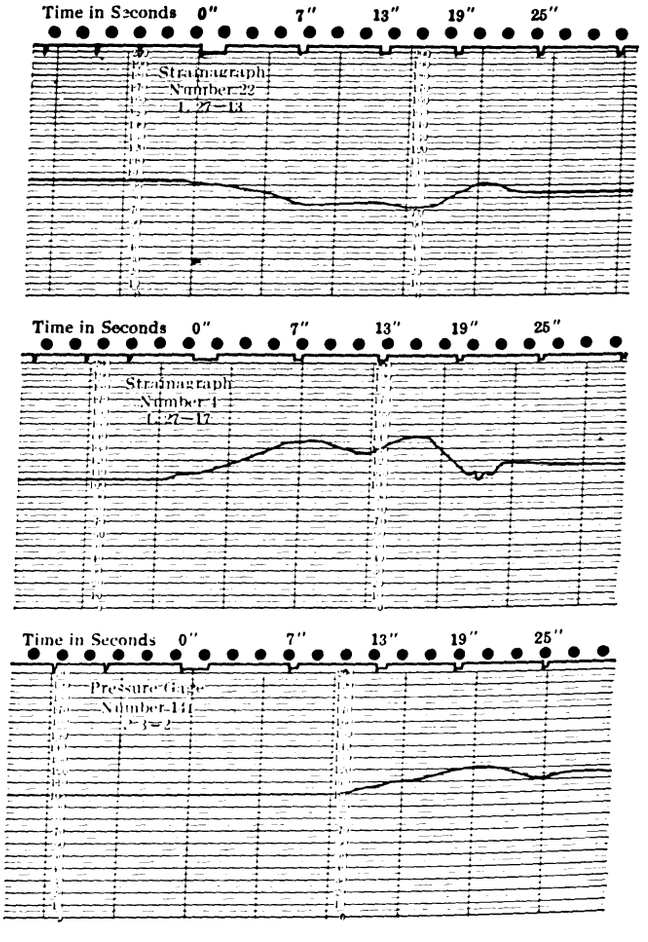
Time in Seconds 0" 7" 13" 19" 25"
Strainagraph Number 22 L 27—13
Time in Seconds 0" 7" 13" 19" 25"
Strainagraph Number 1 L 27—17
Time in Seconds 0" 7" 13" 19" 25"
Pressure Gage Number 141 P 3—2

Fig. 6.—Specimen Records from the Strainagraph

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plied by the modulus of elasticity and divided by the length of the gage line, gives the scale unit, or stress in pounds per square inch corresponding to one unit on the paper scale. It is obtained by dividing the length in inches of one unit on the paper scale by the ratio of multiplication. For the 25 instruments used in these tests the constant varies from 0.000110 to 0.000116.

The ratio of multiplication is determined with the instrument set up as when in service, but with the small casting in which the distance bar is pivoted clamped very lightly. An Ames gage is attached to the adjustable collar at the free end of the distance bar, so that the gage plunger bears against the strainagraph case. By slipping the lightly clamped casting through a slight angle, the pen is moved a small distance. This distance is read and the movement of the Ames gage is also noted. This gives the ratio between the movement of the pen and the true change of length in the gage line. This method of calibration has been found to be not only very convenient, but reliable and accurate as well.

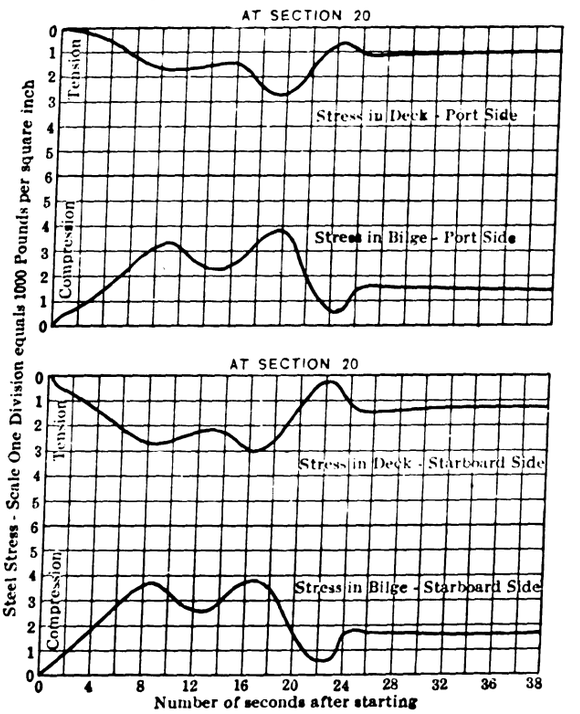
AT SECTION 20
Tension
Compression
Stress in Deck - Port Side
Stress in Bilge - Port Side
AT SECTION 20
Steel Stress - Scale One Division equals 1000 Pounds per square inch
Tension
Compression
Stress in Deck - Starboard Side
Stress in Bilge - Starboard Side
0 4 8 12 16 20 24 28 32 36 38
Number of seconds after starting

Fig. 7.—Longitudinal Stresses at *Atlantus* Launching

APPLICATION OF STRAINAGRAPH TO STUDY OF LAUNCHING STRESSES

The instrument and the interpretation of the records having been described, it remains now to show some of the results obtained from its use.

In the launching at Brunswick, Ga., of the *Atlantus*, the first reinforced concrete ship built under supervision of the Concrete Ship Section of the Emergency Fleet Corporation, the arrangement of instruments shown on the drawings of Fig. 5 was used. As this was an endwise launching, in which it was desired to obtain longitudinal stresses, the significance of the arrangement will be apparent.

Sample records for the strainagraphs at two points during this launching are shown in Fig. 6. It will be noted from the location number given on the records and from the key diagrams of Fig. 5 that these two instruments were located between frames 27 and 28, on the starboard side. The upper record is from the instrument at the deck and the second record from the instrument on the shell just above the inner bottom. The lower record shown in Fig. 6 is one of the pressuregraph records taken during this test.

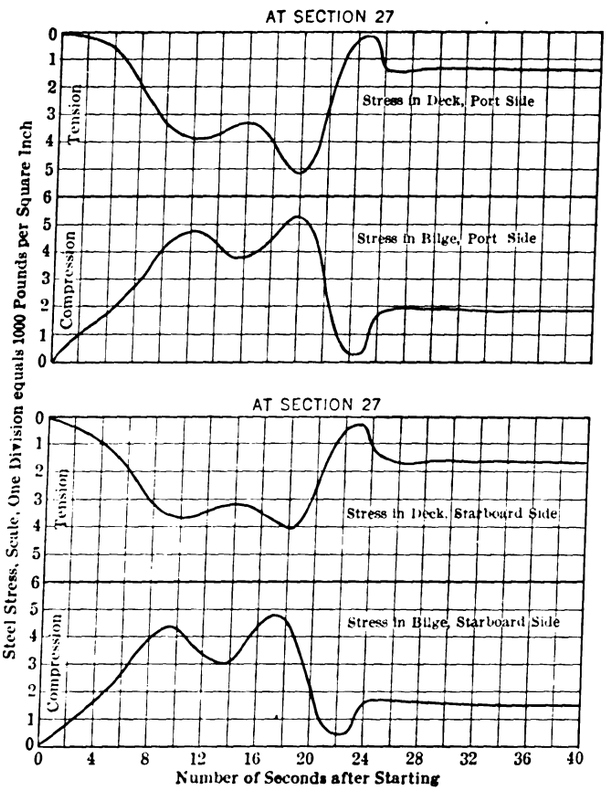
AT SECTION 27
Tension
Compression
Stress in Deck, Port Side
Stress in Bilge, Port Side
AT SECTION 27
Steel Stress, Scale, One Division equals 1000 Pounds per Square Inch
Tension
Compression
Stress in Deck, Starboard Side
Stress in Bilge, Starboard Side
0 4 8 12 16 20 24 28 32 36 40
Number of Seconds after Starting

Fig. 8.—Longitudinal Stresses at *Atlantus* Launching

From the descriptions given previously, the meanings of these records will be clear. The straight portion of the line made by the marking pen at the left of the figure is the record made before the ship began to move. The stress at any instant subsequent to this is referred to this line as a zero. The record for the deck location will be seen to be tension throughout, and that for the lower instrument compression.

On Figs. 7, 8 and 9 are plotted the results from the strainagraphs at the three sections where the instruments were located at both deck and bottom. In preparing these curves the deformations have been reduced to equivalent steel stresses and have been corrected for the positions of the instruments to show the stresses at the extreme top and bottom. In making this correction, straight line variation of stress has been assumed.

RESULTS OF TEST

It is not the purpose of this paper to present a full discussion of the results of this launching, for the combined strain and pressure records provide data for a study too extensive to include here. Therefore, only the briefest discussion will be attempted. The pressure records will not be given, and only one set of results derived from them will be shown for the purpose of illustrating their use. These results are given in Fig. 10 and show the draft for four successive seconds, just before the bow passed off the ways. On this figure the drafts are plotted as ordinates downward from the base line. The full line shows the actual water surface as obtained from the records, and the dotted line shows the plane of the still water surface. On the outline of the ship at the top the

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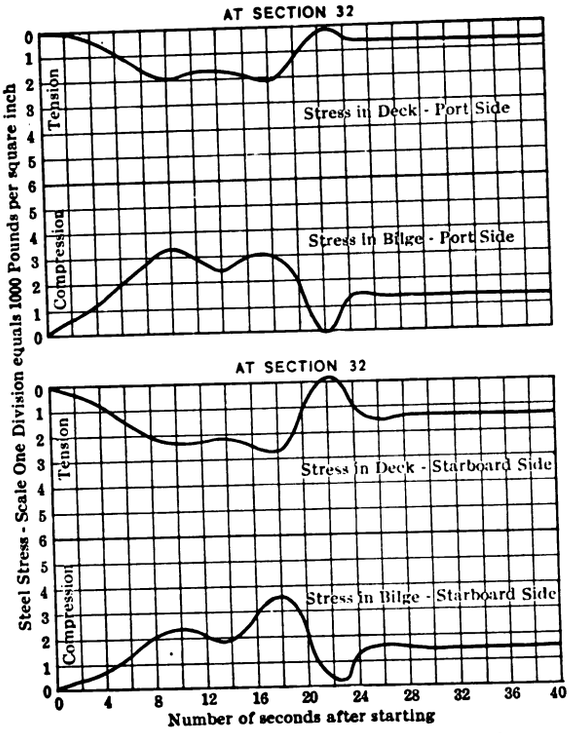
AT SECTION 32
Tension
Compression
Stress in Deck - Port Side
Stress in Bilge - Port Side
AT SECTION 32
Tension
Compression
Stress in Deck - Starboard Side
Stress in Bilge - Starboard Side
Steel Stress - Scale One Division equals 1000 Pounds per square inch
0 4 8 12 16 20 24 28 32 36 40
Number of seconds after starting

Fig. 9.—Longitudinal Stresses at *Atlantus* Launching

actual water surface for the nineteenth second is drawn to the same vertical scale as the ship. It will be noted that the slope of the dotted line, referred to the base line, and, expressed in the proper scale, gives the direction of travel of the ship relative to the water surface. From these and similar curves for other periods the buoyancy has been determined for any instant. The moments given in Fig. 14 were calculated from the buoyancies determined from these curves.

An examination of Figs. 7, 8 and 9 shows that hogging stresses (that is, tension in the deck) began to develop as soon as the hull started to move, and these increased until about the ninth second. Following this will be seen a partial return to a condition of no stress and then a further increase to about the eighteenth second. From the eighteenth to the twenty-second second there was a sharp decrease in the stresses to very nearly zero at all points and a quick return to the condition in which it remained in quiet water.

The stress during the first 12 or 15 seconds was due to a slight vertex in the ways, due to irregularities in construction, over which the hull had to pass. From the sixteenth second the stress was due to the hogging of the ship over the end of the ways. This reduced to almost no stress from the eighteenth to the twenty-second second as the buoyancy at the stern increased. From the twenty-fifth second to the end of the record the hogging stresses are due to the normal hogging moment in the hull.

The variation in stress along the ship at the eighteenth second is shown in Fig. 11. The data for these curves were obtained from the curves of Figs. 7, 8 and 9, and similar curves for other points. This figure shows also the position of the ship on the ways and the observed drafts for that instant. Similar curves for the twenty-second and thirty-second seconds are shown in Figs. 12 and 13. These show respectively the conditions at the time of lowest stress and under the final hogging moments.

The most interesting feature of this test is the comparison of the resisting moment as determined from the strainagraph records with the applied moments as calculated from the observed drafts. This comparison is shown in Fig. 14 for the three sections where measurements were made at both top and bottom. The calculated moments were obtained by the usual calculations based on known weights and buoyancies.

Method of Calculation

In calculating the resisting moments from the strainagraph data the same assumptions were made as were used in the preparation of the design of the ship. These include those usual in the common theory of flexure and the further assumption that the bulwarks and bridge deck did not add to the resisting moment. It should be noted here that the bridge deck and bulwarks were cast separately from the hull and expansion joints were provided about 25 feet apart. All the indications from the data point to the reasonableness of these assumptions and until further data are obtained from the behavior of this ship at sea it seems fair to accept them.

These calculations for resisting moment were made for a beam of homogenous section, giving to the steel area a weight equal to the ratio of its modulus of elasticity to that of the concrete. Tests of 31 cylinder specimens from

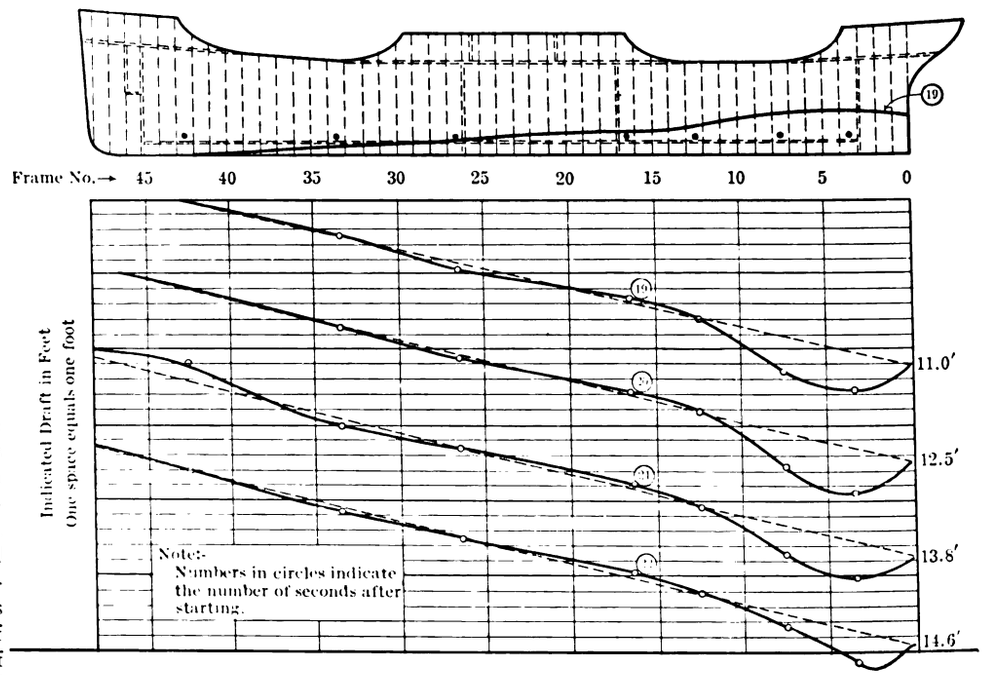
Frame No.→ 45 40 35 30 25 20 15 10 5 0
Indicated Draft in Feet
One space equals one foot
11.0′
12.5′
13.8′
14.6′
Note:-
Numbers in circles indicate the number of seconds after starting.

Fig. 10.—Indicated Draft at One-Second Intervals of Steamship *Atlantus* During Launching

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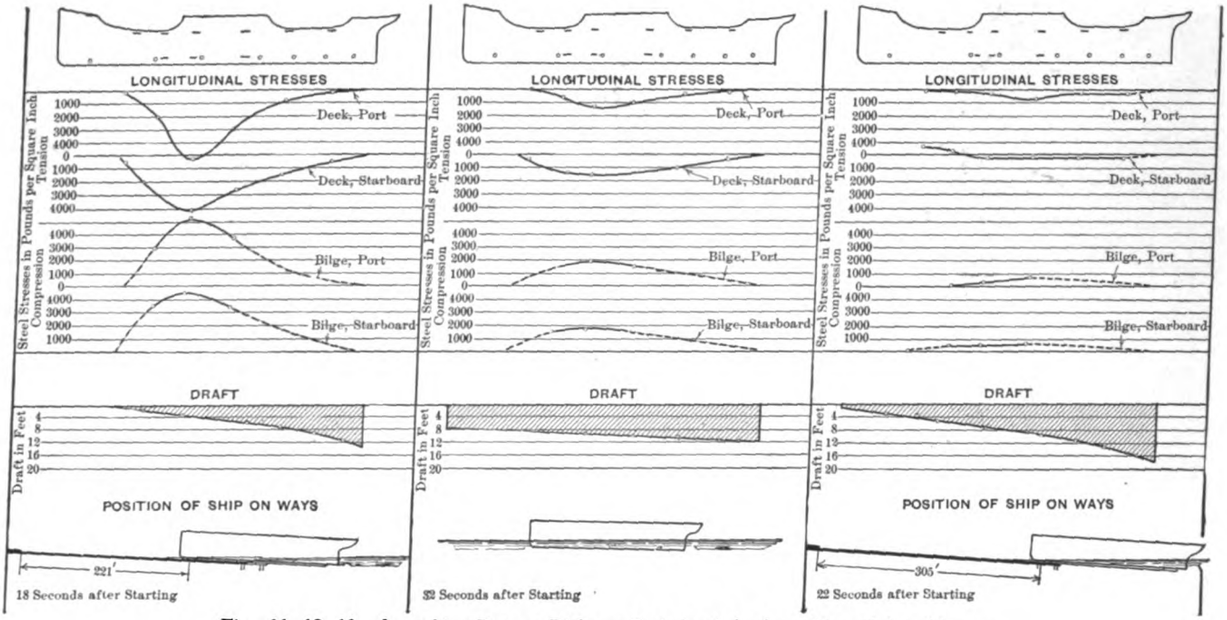

Figs. 11, 12, 13.—Launching Data at Different Periods of the Launching of the *Atlantus*

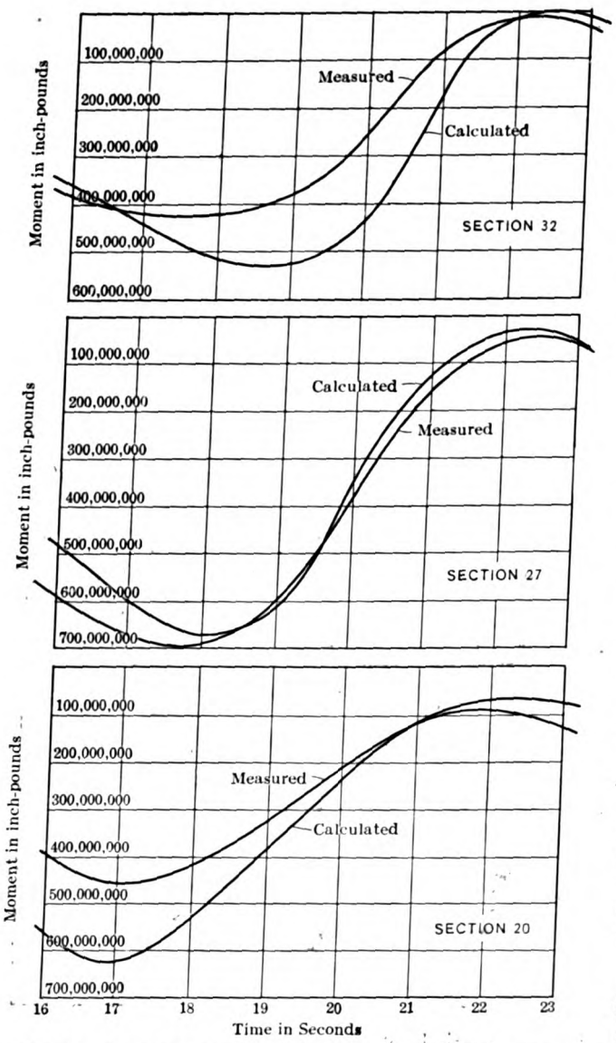

Fig. 14.—Comparison of Measured and Calculated Stresses on the *Atlantus* During Launching

various parts of the ship show an average value of 2,560,000 for the modulus of the concrete. A ratio of 12, therefore, was used on these calculations both for weighting the steel area and in reducing deformations in the concrete to equivalent stresses. The assumption as to the homogeniety of the section is considered fair, as the maximum tension did not exceed 500 pounds per square inch, and there was no evidence of tension cracks after the launching.

Referring now to Fig. 14, the real significance of the agreement between the two sets of curves will be appreciated. These curves represent the moments in the ship during the critical period of launching as determined by two independent sets of measurements of a widely different character. One set of curves gives the calculated applied moments based on water pressure observations, and the other set of curves gives the measured internal moment of resistance based on measured deformations in the hull.

It will be noted that in form the curves for each of the three sections agree remarkably well, also that the agreement in values for section 27 leaves nothing to be desired. In regard to section 20, it can be stated that the calculated moments for the sixteenth, seventeenth and possibly the eighteenth seconds are somewhat too high, for the arangement of pressure instruments was such that they did not record the full buoyancy at these periods. This would indicate better agreement than appears on the curve. In regard to section 32, it may be said that the curve of applied moments at the forward end of the hull cannot be determined as accurately as elsewhere because of the uncertainty in the distribution of the reaction from the ways.

In the light of these considerations it may be stated that the results are very satisfactory and show a high degree of reliability in the instruments. They also give a fair indication of what may be expected in future tests where it will be possible to eliminate some of the uncertainties encountered here.

The Ropner Shipbuilding & Repair Company (Stockton) Ltd., of Stockton-on-Tees, recently launched the single screw steel steamer *Atlantic City* for Cardiff owners. The vessel is 411 feet 6 inches long between perpendiculars, 54 feet 6 inches beam and 36 feet 4½ inches depth.

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Fig. 1.—Waterfront of Winnisimmet Repair Yard

Winnisimmet Ship Repair Plant

Latest Addition to Ship Repair Facilities in Boston Harbor—Has Largest Railway Dry Dock in New England

BY E. P. B. RANKIN

BOSTON is once more to the fore in the all-important matter of port development, for there has just been completed at the Winnisimmet Ship Yard, Inc., at the extreme head of Boston Harbor where it makes into Chelsea Creek, not only the largest marine railway dry dock at this port but the largest in New England. It might further be added that the contract for its construction was executed in record time.

This latest port improvement marks the consummation of one of several features planned by the Winnisimmet company several months ago. It was soon after the organization of the company in June, 1918, that the old Winnisimmet ferry site was obtained and immediately the work of outlining plans for the plant was begun. These plans called for an enlargement of the site, remodelling of buildings, the construction of three piers, the building of a marine railway and the necessary power house and minor improvements and additions.

Work on the marine railway, the most important and necessary feature of the plans, was begun on May 26, 1919, requiring the excavation of 10,000 cubic yards of material by steam shovels on land, the driving of 700 oak piles as foundations for the four-track railway for the dry dock, the dredging of 51,147 cubic yards of material at the outboard end of the dock and the construction of retaining walls on either side of the railway, extending into the water. This part of the work represented 1,200 linear feet of retaining wall from 6 to 20 feet in height, which required 1,700 cubic yards of concrete in its construction and 700 cubic yards of granite blocks for facing.

The Railway Dry Dock

The cradle of the dry dock was constructed of long leaf yellow pine, with white oak keel blocks and spruce decking. As it stands completed, it has a hauling capacity of 4,000 tons. It measures 340 feet in length over the deck and

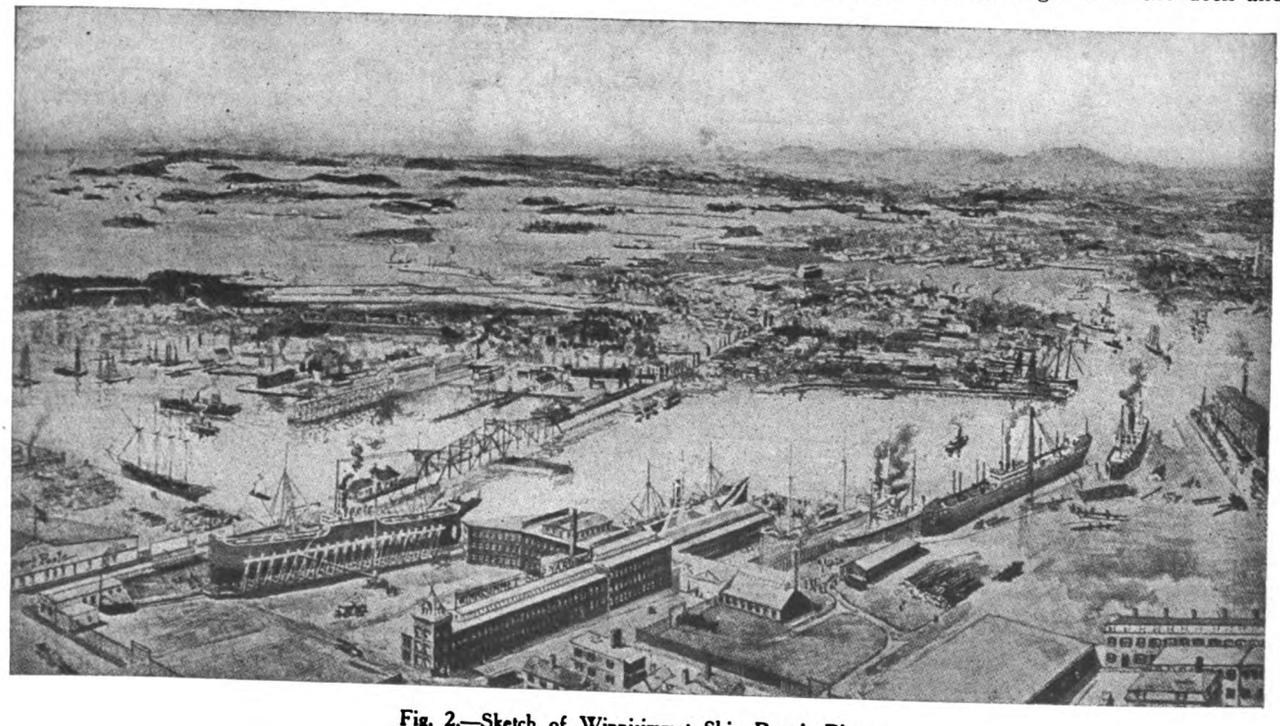

Fig. 2.—Sketch of Winnisimmet Ship Repair Plant

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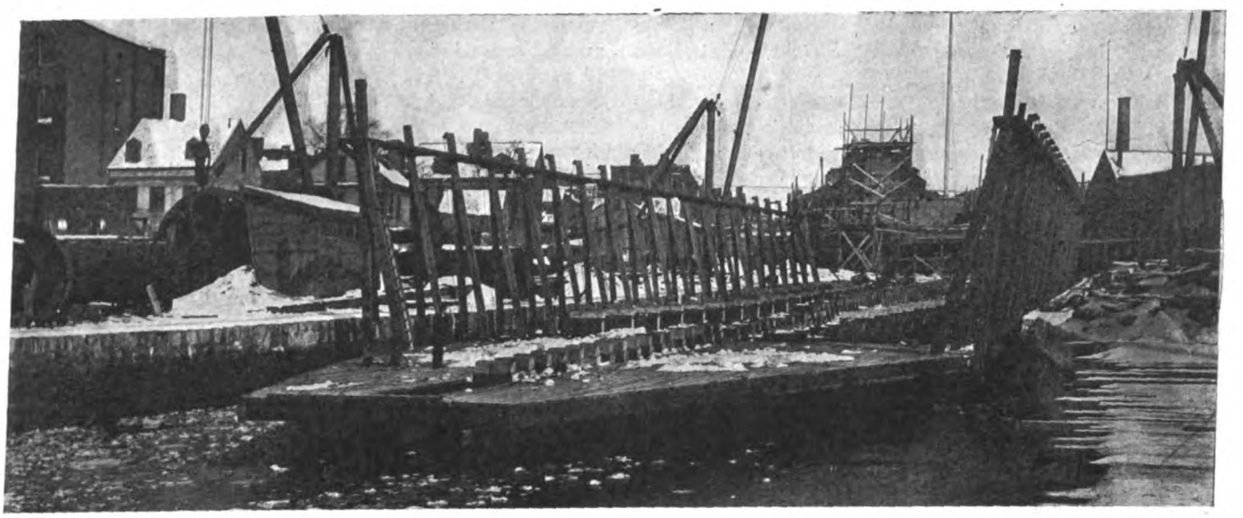

Fig. 3.—Railway Dry Dock, Winnisimmet Shipyard, Inc.; Capacity, 4,000 Tons

320 feet over the keel blocks and is 68 feet wide. There is a depth of 19 feet at mean high water over the keel blocks aft and 14 feet mean high water over the keel blocks forward. The deck is 2 feet 3 inches out of water at mean high water. The railway dry dock was designed and its construction was superintended by the Crandall Engineering Company, East Boston, Mass.

EQUIPMENT OF THE POWER HOUSE

While all this work was advancing on the railway itself, the power house was also under construction. It is of brick, and when finished will be two stories high, with the exception of the space over the boilers. It will be 90 feet long and 50 feet wide and will have a 70-foot stack.

The power house is equipped with two boilers of the horizontal, multitubular type, 6½ feet in diameter and 22 feet long, of 125 horsepower, either being capable of handling the railway in case of necessity. The machinery is of a special type designed for this kind of a railway, the cylinders of the engine being 14½ inches by 18 inches. The largest gear (one casting) weighs 39,800 pounds, and the outfit is easily capable of handling the four hauling chains of 2⅝ inches which are used.

The number of employees at the new plant bids fair to reach the 1,000 mark before long. One of the main buildings is 75 feet long and 48 feet wide, and another 148 feet long and 58 feet wide, both built of brick, the former three stories and the latter two stories in height. In the former is housed the clerical force, drafting rooms, restaurant and storeroom, while the other is occupied by the

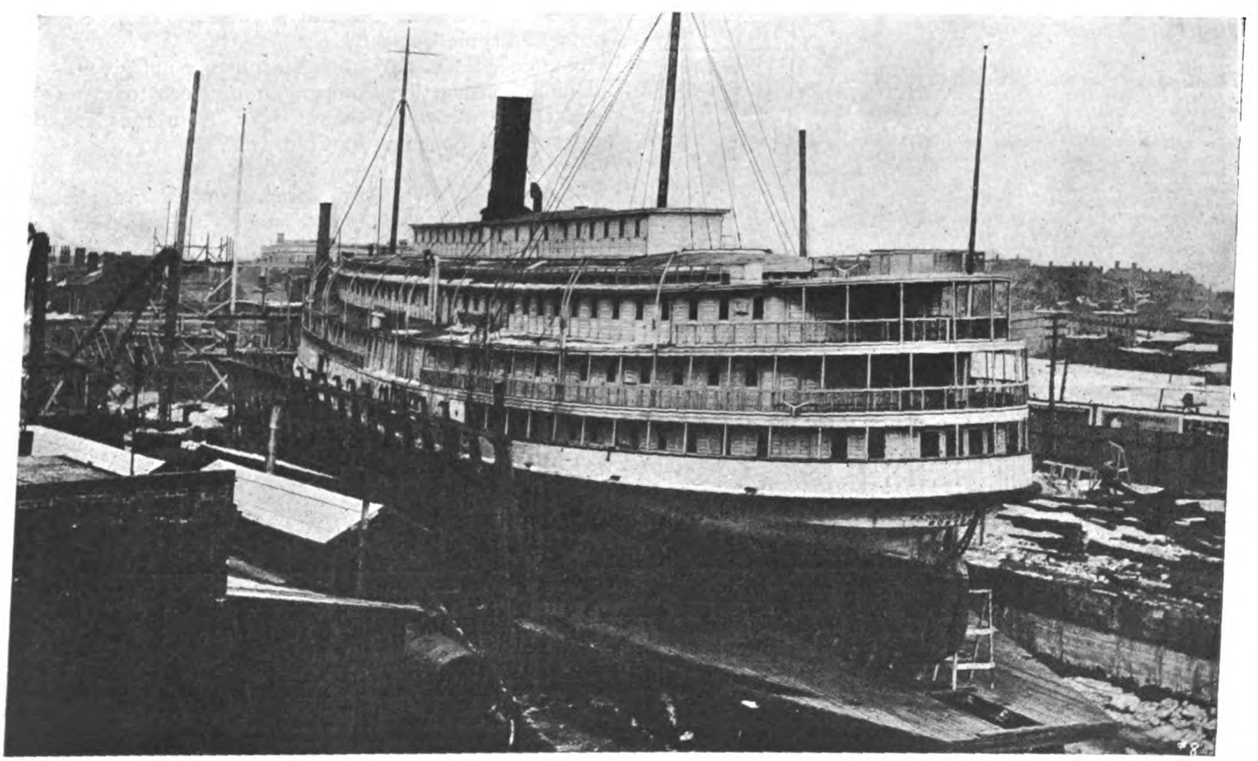

Fig. 4.—S. S. *Ransom B. Fuller* Undergoing Repairs in Winnisimmet Dry Dock

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machine shop, tinsmith shop and joiners' shop. The blacksmith, boiler shop, riggers', calkers' and paint shops are in other smaller buildings.

Included in plans for the future is the erection of a thoroughly up-to-date boiler shop, while under way at the present time is the construction of two piers, one on either side of the new railway, No. 1 having just been completed, being 171 feet long and 20 feet wide. Work on No. 2 is progressing, and when finished it will be 330 feet long and 28 feet wide. Work on No. 3 has not yet been started, but when it is completed it will be 530 feet long and 35 feet wide. The lengths of all of the piers had to be governed by the pierhead line. All are of wooden pile construction.

Piers No. 2 and No. 3 will form a dock 110 feet wide for the mooring of steamers and other craft while undergoing repairs or while waiting their turns to go on the railway, and will be dredged to afford ample depth for the larger type of vessels. Other plans of a minor nature will be developed in the future.

Steel Ships Under Construction in American Shipyards for Private Account

PRIVATE orders in hand in American shipyards at the beginning of May, according to a statement just issued by the Atlantic Coast Shipbuilders' Association, aggregated 296 vessels of 1,404,698 gross tons. Foreign orders placed with American yards aggregate nearly 100,000 tons. The status of the various types of tonnage by monthly periods has been as follows:

1919	Tankers	Freighters	Other Types
October	74,437	235,523	37,383
November	214,940	295,493	40,281
December	369,084	400,556	35,507
1920			
January	476,742	470,197	30,549
February	588,565	620,567	47,441
March	722,549	561,455	53,441
April	745,140	623,917	35,641

Orders for tankers now in hand for various companies are as follows:

	No.	Gross Tons
Standard Oil Companies	23	181,410
Atlantic, Gulf & West Indies Company	14	116,100
Standard Transport Company	11	85,380
Union Oil Company	6	47,800
Sinclair Navigation Company	8	48,800
Pan-American Petroleum Company	6	36,571
Texas Company	4	23,600
Vacuum Oil Company	3	19,650
Anglo-Mexican Oil Company	4	21,000
Gulf Refining Company	3	18,900
Baltimore Dry Dock & Shipbuilding Company	2	12,000
General Petroleum Company	3	21,500
Ore Steamship Company	1	13,500
International Petroleum Company	1	13,500
W. A. Harriman & Company	2	12,500
New York Shipbuilding Corporation	2	12,200
Southern Pacific Company	1	12,000
French Owners	6	8,226
Owners Not Given	1	9,100
Societe Anonyme d'Armement	1	8,600
W. R. Grace & Company	1	7,753
Sun Company	1	6,800
American Sugar Refining Company	1	4,200
Galena Signal Oil Company	1	2,500
Tidewater Oil Company	1	1,200
Nyack Shipbuilding Company	1	950
TOTAL	108	745,140

New orders reported during April were as follows:

Freighters

Baltimore Dry Dock & Ship Building Company, 1 of 5,600 tons for builders' account.

Wm. Cramp & Sons, 1 of 2,000 tons for the Peninsula & Occidental Steamship Company.

J. F. Duthie, 2 of 1,500 tons each for the Coastwise Steamship Company.

Manitowoc Shipbuilding Company, 3 of 2,712 tons each for builders' account.

McDougall-Duluth Company, 4 of 2,338 tons each for the Sugar Products Company.

Merchant Shipbuilding Corporation, 2 of 7,500 tons each for the American-Hawaiian Company.

Tankers

Bethlehem Shipbuilding Corporation, Harlan plant, 2 of 4,500 tons each for the Sinclair Navigation Company; San Francisco plant, 1 of 8,650 tons for the Standard Oil Company of California.

Moore Shipbuilding Company, 1 of 12,000 tons for the Southern Pacific Company.

Skinner & Eddy, 1 of 9,100 tons, owner not given.

Union Construction Company, 1 of 7,000 tons for the General Petroleum Company; 1 of 1,650 tons for the Standard Oil Company of California.

Other Types

Bethlehem Shipbuilding Corporation, Moore plant, 2 refrigerator steamers of 1,400 tons each for the National Products Company.

Downey Shipbuilding Corporation, 1 oil carrier of 500 tons for the Mexican Petroleum Company.

Federal Shipbuilding Company, Kearney, N. J., plant, 4 barges of 450 tons each for the Mexican Petroleum Company; 4 barges of 500 tons each for the Sinclair Navigation Company.

The following table, compiled by the Atlantic Coast Shipbuilders Association, shows the volume of tonnage building for private account:

STEEL VESSELS UNDER CONSTRUCTION IN AMERICAN SHIPYARDS FOR PRIVATE ACCOUNT

Builders	Owners	Type	Gross Tonnage	No.	Total Tonnage
Alabama & New Orleans Transportation Company	Pan-American Petroleum & Transportation Company	Tanker*	1,371	1	1,371
American Bridge Company	Missouri Portland Cement Company	Barge x	300	3	900
American Shipbuilding Company	Builders	Freighter*	2,338	10	23,380
American Shipbuilding Company	Builders	Freighter†	7,700	4	30,800
Baltimore Dry Dock & Shipbuilding Company	Builders	Tanker†	6,000	2	12,000
Baltimore Dry Dock & Shipbuilding Company	Builders	Freighter*	4,311	2	8,622
Bath Iron Works	Crowell & Thurlow	Freighter*	5,600	1	5,600
Bayles Shipbuilding Company	Nyack Shipbuilding Company	Tanker†	950	1	950
Bethlehem Shipbuilding Company:					
Fore River	Atlantic, Gulf & West Indies Company	Tanker*	8,900	1	8,900
Fore River	Ore Steamship Company	Ore-Carrier†	7,150	1	7,150
Fore River	Sinclair Navigation Company	Tanker*	6,600	2	13,200
Fore River	Standard Transportation Company	Tanker*†	7,794	2	15,588
Fore River	Standard Transportation Company	Tanker*	8,900	2	17,800

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STEEL VESSELS UNDER CONSTRUCTION IN AMERICAN SHIPYARDS FOR PRIVATE ACCOUNT—CONTINUED

BUILDERS	OWNERS	TYPE	GROSS TONNAGE	No.	TOTAL TONNAGE
Bethlehem Shipbuilding Company:					
Harlan Plant	Sinclair Navigation Company	Tanker*†	6,600	2	13,200
Harlan Plant	Sinclair Navigation Company	Tanker†	4,500	2	9,000
Moore Plant	National Products Company	Refrigerated*	1,400	2	2,800
Sparrows Point	Ore Steamship Company	Tanker†	13,500	1	13,500
Sparrows Point	International Petroleum Company	Tanker†	13,500	1	13,500
Sparrows Point	Atlantic, Gulf & West Indies Company	Tanker*	7,500	1	7,500
Sparrows Point	Atlantic, Gulf & West Indies Company	Tanker†	7,800	2	15,600
Sparrows Point	Standard Transport Company	Tanker†	6,900	1	6,900
Sparrows Point	Standard Transport Company	Tanker*	7,500	1	7,500
Sparrows Point	Standard Transport Company	Tanker*	7,150	1	7,150
Sparrows Point	Vacuum Oil Company	Tanker*	7,150	1	7,150
San Francisco	General Petroleum Company	Tanker*	7,500	1	7,500
San Francisco	Pan-American Petroleum & Transportation Company	Tanker*†	7,060	3	21,800
San Francisco	Standard Oil of California	Tanker†	7,060	1	7,060
San Francisco	Standard Oil of California	Tanker†	8,650	1	8,650
San Francisco	Standard Transport Company	Tanker†	7,060	1	7,060
San Francisco	Standard Oil of New York	Tanker*	7,500	1	7,500
Brunswick Marine Corporation	R. L. Smith	Barge*	1,250	1	1,250
Clinton Shipbuilding & Repair Company	Baldwin Locomotive Works	Lighter x	1,600	1	1,250
Clinton Shipbuilding & Repair Company	Atlantic Refining Oil Company	Oil Barge x	600	2	1,200
Clinton Shipbuilding & Repair Company	Union Petroleum Company	Oil Barge x	326	1	326
Clinton Shipbuilding & Repair Company	Union Petroleum Company	Oil Barge	1,200	1	1,200
Clinton Shipbuilding & Repair Company	Union Petroleum Company	Barge x	326	1	326
Cramp & Sons	Florida & East Coast Ry	Freighter x	2,406	1	2,406
Cramp & Sons	Peninsula & Occidental Steamship Company	Pass. and Cargo†	2,000	1	2,000
Oscar Daniels Company	Standard Oil Company	Tanker*	7,800	2	15,600
J. F. Duthie	Coastwise Steamship Company	Freighter†	1,500	2	3,000
Downey Shipbuilding Corporation	Southern Pacific Company	Freighterx	4,000	3	12,000
Downey Shipbuilding Corporation	Mexican Petroleum Company	Oil-Carrier	500	1	500
Federal Shipbuilding Company:					
Kearney, N. J.	Freeport Sulphur Company	Freighter†	4,127	2	8,254
Kearney, N. J.	Sinclair Navigation Company	Barge*	500	4	2,000
Kearney, N. J.	Standard Oil Company	Tanker*	10,000	5	50,000
Kearney, N. J.	Mexican Petroleum Company	Barge*	450	4	1,800
Kearney, N. J.	United States Steel Corporation	Freighter†	6,000	10	60,000
Chickasaw, Ala.	Builders	Freighter*	6,869	4	27,476
Chickasaw, Ala.	United States Steel Corporation	Freighter†	6,000	10	60,000
George A. Fuller Company	Builders	Freighter*	6,527	4	26,108
Greenpoint Shipbuilding Company	Bay State Fisheries Company	Trawler†	292	2	584
International Shipbuilding Company	J. A. Bandi	Freighter*	4,200	8	25,600
Johnson Iron Works	Cortez Oil Corporation	Oil Barge†	200	1	200
Kyle & Purdy	East Coast Fisheries Company	Trawler*	355	2	710
Long Beach Shipbuilding Company	Standard Oil of California	Tanker†	2,100	1	2,100
Long Beach Shipbuilding Company	California Mexico Shipbuilding Company	Freighter x	1,150	1	1,150
Long Beach Shipbuilding Company	Domingo-Nazabel Company	Freighter x	1,200	1	1,200
Manitowoc Shipbuilding Company	Atlantic Fruit Company	Fruit-Steamer*	2,000	2	4,000
Manitowoc Shipbuilding Company	Builders	Freighter*	2,712	3	8,136
McDougall-Duluth Company	Sugar Products Company	Freighter	2,338	5	11,690
Merchant Shipbuilding Corporation	Union Oil of Delaware	Tanker*	6,250	2	12,500
Merchant Shipbuilding Corporation	American-Hawaiian Steamship Company	Freighter*	7,500	2	15,000
Merchant Shipbuilding Corporation	Shawmut Steamship Company	Freighter*	7,300	2	14,600
Merchant Shipbuilding Corporation	W. A. Harriman & Company	Tanker*	6,250	2	12,500
Moore Shipbuilding Company	Matson Navigation Company	Freighter*†	9,500	2	19,000
Moore Shipbuilding Company	Standard Oil Company of California	Tanker†	3,250	1	3,250
Moore Shipbuilding Company	Standard Oil of New Jersey	Tanker†	7,000	3	21,000
Moore Shipbuilding Company	Vacuum Oil Company	Tanker*	6,250	2	12,500
Moore Shipbuilding Company	Southern Pacific Company	Tanker x	12,000	1	12,000
National Shipbuilding Company	French Owners	Tanker*	1,371	6	8,226
National Shipbuilding Company	Cuyamel Fruit Company	Fruit-Steamer x	250	3	750
Newburgh Shipyards, Incorporated	Cuyamel Fruit Company	Freighter*	3,000	2	6,000
Newburgh Shipyards, Incorporated	Union Sulphur Company	Freighter*	4,700	2	9,400
New Jersey Dry Dock Company	East Coast Fisheries Company	Trawler*	355	2	710
Newport News Shipbuilding Company	Atlantic, Gulf & West Indies Company	Tanker†	10,600	2	2,200
Newport News Shipbuilding Company	Standard Oil of New Jersey	Tanker*	13,500	2	27,000
New York Shipbuilding Corporation	W. R. Grace & Company	Tanker*	7,753	1	7,753
New York Shipbuilding Corporation	Builders	Tanker*	6,100	2	12,200
New York Shipbuilding Corporation	Standard Transport Company	Tanker*	7,794	3	23,382
Pusey & Jones Company	Eastern Steamship Company	Freighter x	2,700	1	2,700
Pusey & Jones Company	Not Given	Tanker*	9,100	1	9,100
Southwestern Shipbuilding Company	Builders	Freighter*†	6,100	1	6,100
Southwestern Shipbuilding Company	Union Oil of California	Tanker*†	8,650	2	17,300
Spedden Shipbuilding Company	Standard Oil Company	Oil Barge†	995	1	995
Standard Shipbuilding Corporation	Cuyamel Fruit Company	Fruit-Steamer*	1,500	2	3,000
Standard Shipbuilding Corporation	Anglo-Mexican Oil Company	Tanker*	5,250	4	21,000
G. M. Standifer Construction Company	Green Star Line	Freighter*	6,165	5	30,825
G. M. Standifer Construction Company	Standard Oil of New Jersey	Tanker*	8,000	3	24,000
Staten Island Shipbuilding Company	Galena Signal Oil Company	Tanker*	2,500	1	2,500
Staten Island Shipbuilding Company	American Sugar Refining Company	Tanker†	4,200	1	4,200
Staten Island Shipbuilding Company	Standard Oil of New York	Barge x	420	6	2,520
Staten Island Shipbuilding Company	Standard Oil of New York	Barge x	450	1	450
Staten Island Shipbuilding Company	Tidewater Oil Company	Tanker x	1,200	1	1,200
Submarine Boat Corporation	Builders	Freighter*†	3,545	32	113,440
Sun Shipbuilding Company	Atlantic, Gulf & West Indies Company	Tanker†	6,800	1	6,800
Sun Shipbuilding Company	Atlantic, Gulf & West Indies Company	Tanker*	9,000	4	36,000
Sun Shipbuilding Company	Atlantic, Gulf & West Indies Company	Tanker*	6,700	3	20,100
Sun Shipbuilding Company	Gulf Refining Company	Tanker*	6,700	1	6,700
Sun Shipbuilding Company	Pan-American Petroleum & Transportation Company	Tanker*	5,700	2	13,400
Sun Shipbuilding Company	Rotterdamsche Lloyd	Freighter*	7,700	1	7,700
Sun Shipbuilding Company	Sinclair Navigation Company	Tanker*	6,700	2	13,400
Sun Shipbuilding Company	Standard Oil of New Jersey	Tanker*	6,800	2	13,600
Sun Shipbuilding Company	Sun Company	Tanker*†	6,800	1	6,800
Sun Shipbuilding Company	Union Oil Company	Tanker*	9,000	2	18,000
Sun Shipbuilding Company	Societe Anonyne d'Orient d'Industrie	Tanker x	8,000	1	8,000
Tank Steamship Corporation	Southern Oil & Transportation Company	Oil Barge*	835	2	1,670
Tank Steamship Corporation	Southern Oil & Transportation Company	Oil Barge*	775	2	1,550
Texas Company	Builders	Tanker*	3,500	1	3,500
Texas Company	Builders	Tanker x	6,700	3	20,100
Todd Shipyards Corporation	Sinclair Navigation Company	Oil Barge*	1,800	1	1,800
Todd Shipyard Corporation	Donald Steamship Company	Fruit-Steamer*	1,400	2	2,800
Todd Dry Dock & Construction Company	Stock	Freighter*†	4,600	2	9,200
Toledo Shipbuilding Company	Not Given	Freighter*	2,560	3	7,680
Union Shipbuilding Company	Aluminum Company of America	Freighter*	3,100	2	6,200
Union Shipbuilding Company	Builders	Freighter*†	7,150	2	14,300
Union Shipbuilding Company	Gulf Refining Company	Tanker*	6,100	2	12,200
Union Construction Company	General Petroleum Company	Tanker*†	7,000	1	7,000
Union Construction Company	General Petroleum Company	Tanker†	7,000	1	7,000
Union Construction Company	Standard Oil of California	Tanker†	1,650	1	1,650
Virginia Shipbuilding Corporation	United States Steamship Company	Freighter*†	6,200	6	37,200

Total building: 296 ships, aggregating 1,404,698 gross tons

NOTE: † Classified by American Bureau of Shipping. * Classified by Lloyd's Register of Shipping. x Reported by United States Bureau of Navigation.

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Freight Handling at Marine Terminals

Modern Methods Used in Loading and Discharging Vessels at Boston Army Supply Base—Mechanical Equipment Operated by Electricity

BY A. K. WEST*

INDUSTRY is appreciating more every day the truth of the axiom that efficiency increases in direct proportion to the extent that hand labor and haphazard methods of handling material are replaced by machines, the more automatic in principle the better. In marine terminals, where this principle would demonstrate its value to a great degree, there has apparently been no concerted effort to replace time-honored, expensive and casual methods that have nothing to recommend them but their venerability with modern mechanical and efficient means of handling of freight.

The result is that at most of such terminals the congestion both on the piers and in the warehouses and freight yards is tremendous; and the costs of loading and unloading—in fact, of all the necessary handling—have soared until it costs as much to load a barrel into a car at Chicago and unload it at New York as it does to transport it between the two cities. With the inevitable increase in production, unless something is done to better the terminal conditions at our large ports they are going to be very congested, and the commerce of the country will sustain losses that can be figured only in millions of dollars.

There are two remedies for this state of affairs, which, if properly considered and intelligently applied, would greatly relieve, if not altogether eliminate, such conditions. One is the proper layout and construction of wharves, storage centers and railroad facilities so that they would be mutually accessible for the handling and disposal of freight, and the other is the installation of mechanical handling devices for moving this freight, replacing manual methods.

In discussing such mechanical methods, it should be borne in mind that the requirements of the situation will be flexibility, compactness and accurate, reliable operation. These requirements are most efficiently met by handling machinery which has electricity for motive power, such as cranes, deck winches, tractors and similar devices. This is true for various easily explained reasons. One is that piers being badly congested under the best of cir-

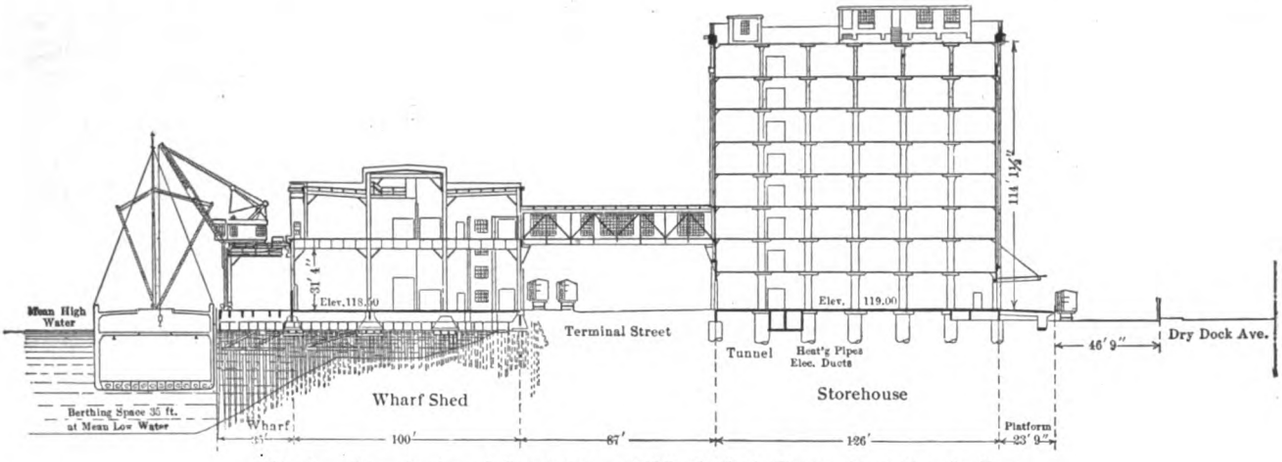

Fig. 1.—Cross Section of Storehouse and Wharf Shed, Boston Army Supply Base

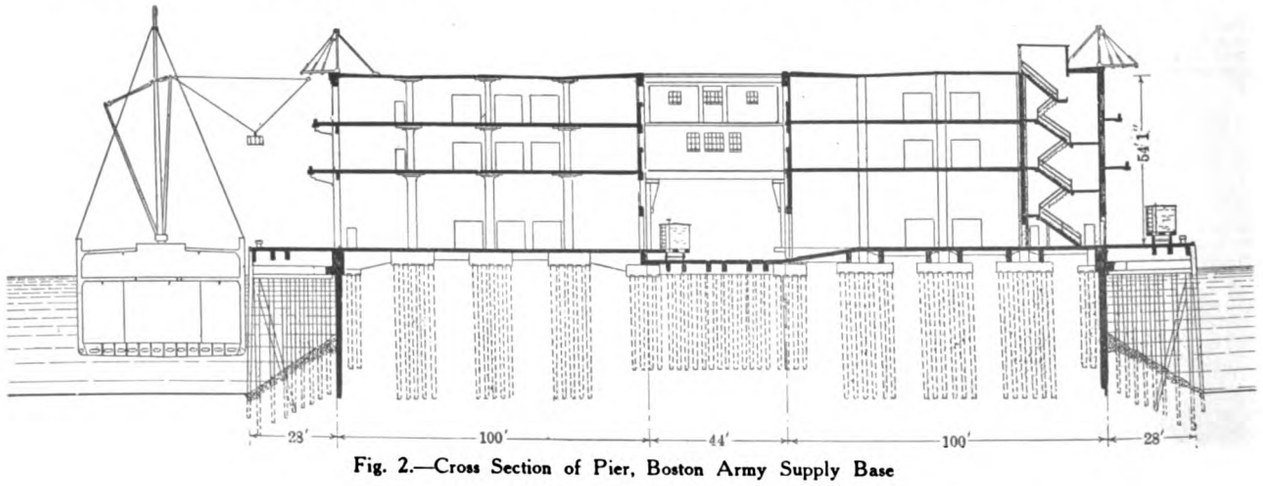

Fig. 2.—Cross Section of Pier, Boston Army Supply Base

* General Electric Company, Schenectady, N. Y.

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Testing the Hull Structure of Ships—II

Watertight Bulkheads—Rules and Methods for Testing Tanks Used for Carrying Fuel Oil—Fuel Oil Bunkers and Settling Tanks

BY F. K. RUPRECHT

TEST NO. 6.—AFTER COLLISION BULKHEAD

(*a*) *Object*

To test strength and tightness of the bulkhead and tightness of all connections thereto. While the shell must of course be tight, the test is primarily to test the bulkhead.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

While there is no definite rule to cover this particular case, it appears that a hose test is all that would be required, the pressure in the nozzle to be at least 30 pounds per square inch.

2. British Lloyd's Register.

To be tested by filling the peaks with water to the height of the load waterline.

3. Bureau Veritas.

To be tested by filling the fore peak with water. (Note.—No head is given, but it is assumed that it shall be to the freeboard deck or at least to the load waterline.)

(*c*) *Procedure of Testing*

Test before cementing, cement washing or painting with bitumastic and before launching, if possible, although the latter is not a requirement, and after all work within and adjacent to the bulkhead has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to launching date or other contingencies, the final approval of test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a retest obligatory.

Fill the after peak compartment, i. e., that space between the stern and the collision bulkhead, with water to a height equal to *at least* the load waterline. If there is a calked watertight deck above this level, it is well to fill to this level, since this would be more nearly the head the bulkhead must withstand in case of a damaging collision. No leaks should develop at this head and the deflection of the bulkhead should be reasonably small. Any leaks which are found should be made good by legitimate means and any excess deflection should be corrected by additional stiffening, all to the satisfaction of the surveyor.

TEST NO. 7.—WATERTIGHT BULKHEADS OTHER THAN COLLISION OR TANK BULKHEADS

(*a*) *Object*

To test the tightness of the bulkheads and all fittings and connections thereto.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested with a hose, the pressure of water being not less than 30 pounds per square inch, under simultaneous inspection on both sides of the plating.

2. British Lloyd's Register.

To be tested with a hose, the pressure of water in the hose being not less than 30 pounds per square inch, under simultaneous inspection on both sides of the plating.

3. Bureau Veritas.

To be tested with a hose. (Note.—No requirement as to pressure is given.)

(*c*) *Procedure of Testing*

Test before cementing, cement washing or painting with bitumastic, but at any convenient time and after all work within and adjacent to bulkhead has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, the final approval of test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory.

Direct a stream of water from a hose at the required pressure against the bulkhead in a systematic manner so as to test the tightness of all boundary angles, seams and butts, and all rivets, watertight doors and pipe connections, starting at the bottom and working up from side to side as directed by the surveyor and at a speed which will permit careful inspection by a surveyor on the opposite side. Any leaks detected are to be made good by legitimate means and to the satisfaction of the surveyor.

TEST NO. 8.—FORE PEAK TANK, IF USED FOR FUEL OIL

(*a*) *Object*

To test oiltightness and strength of peak bulkhead, shell in way of tank, deck forming crown of tank, manholes, hatches and pipe connections to bulkhead, tank top or shell.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested with a head of water at least one foot above the highest point to which oil has access in pipes (vent, overflow of filling lines), hatchways or elsewhere; or to a head of not less than eight feet above the highest point of the compartment, whichever is highest.

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline or twelve feet above the highest point of the compartment, whichever of these is the greater. In the 1920 edition of Lloyd's Rules the requirement of twelve feet above the load waterline has been modified to read to load waterline. The alternative requirements, however, are unchanged.

3. Bureau Veritas.

To be tested with a head of water extending to the upper deck, and at least thirteen feet above the crown of the tank.

(*c*) *Procedure of Testing*

Test before launching and before painting or coating with bitumastic and after all work within the tank and adjacent to the tank has been completed and the work-

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manship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to some contingency, the final approval of test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory.

Fit a standpipe onto tank top (vent or filling connection may be used) and carry the pipe to the prescribed height fitting a large funnel or other container at the top, the height of which is to be such as to show the level of the water when at the testing head. No leaks or defects should develop at this pressure, and any found should of course be made good by legitimate means to the satisfaction of the surveyor. Often it is not possible to test completely before launching, and in this contingency it is necessary to have a preliminary test to insure the tightness of the shell in way of tank. In this case the tank is filled with water to the level of the crown of the tank and the shell is made tight to the satisfaction of the surveyor.

Since the tank is to carry oil, and in view of the fact that oil is more searching than water, the surveyor's inspection and test will usually be more rigid and a superior job will be insisted upon throughout.

TEST NO. 9.—AFTER PEAK TANK, IF USED FOR FUEL OIL

(*a*) *Object*

To test oiltightness and strength of peak bulkhead, shell in way of tank, deck forming crown of tank, manholes, hatches and pipe connections to bulkhead, tank top or shell.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested with a head of water at least one foot above the highest point to which oil has access in pipes (vent, overflow of filling lines) hatchways or elsewhere; or to a head of not less than eight feet above the highest point of the compartment, whichever is highest.

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline or twelve feet above the highest point of the compartment, whichever of these is the greater. In the 1920 edition of Lloyd's Rules the requirements of 12 feet above the load waterline has been modified to read to load waterline. The alternative requirements, however, are unchanged.

3. Bureau Veritas.

To be tested with a head of water extending to the upper deck, and at least thirteen feet above the crown of the tank.

(*c*) *Procedure of Testing*

Test before launching and before painting or coating with bitumastic and after all work within and adjacent to the tank has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to some contingency, the final approval of test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory.

Fit a standpipe onto the tank top (vent or filling connections may be used) and carry the pipe to the prescribed height, fitting a large funnel or other container at the top, the height of which is to be such as to show the level of the water when at the testing head. No leaks or defects should develop at this pressure, and any found should of course be made good by legitimate means to the satisfaction of the surveyor. Often it is not possible to test completely before launching, and in this contingency it is necessary to have a preliminary test to insure the tightness of the shell in way of tank. In this case the tank is filled with water to the level of crown of the tank and the shell made tight to the satisfaction of the surveyor.

Since the tank is to carry oil, and in view of the fact that oil is more searching than water, the surveyor's inspection and test will usually be more rigid and a superior job will be insisted upon throughout.

TEST NO. 10.—DOUBLE BOTTOM TANKS, IF USED FOR FUEL OIL

(*a*) *Object*

To test oiltightness of shell plating in way of double bottom tank top plating, and margin plate strength and tightness of watertight floors and centerline division plating (centerline girder), manholes and pipe connections to tank top, watertight floors, centerline girder or to shell.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested before launching with a head of water at least one foot above the highest point to which oil has access to pipes, i. e., (filling vent or overflow pipes).

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline.

3. Bureau Veritas.

To be tested before launching with a head of water extending to the upper deck.

(*c*) *Procedure of Testing*

Test before launching and before painting with bitumastic or cementing or cement washing, and after all work within and adjacent to the tank has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to launching date or other contingencies, the final approval of the test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory. Each tank is to be tested separately so all sides of divisional floors or girders such as watertight centerline girder may be observed.

Fit a standpipe to the tank top (vent or filling line may be used) with a large funnel or other container at the top and at such a height that the level of the water at the required head will show in the container. No leaks or defects should develop at this head, and any found should be made good by legitimate means to the satisfaction of the surveyor.

Since these tanks are to carry oil, and in view of the fact that oil is more searching than water, the surveyor's inspection and test will usually be more rigid and a superior job will be insisted upon throughout.

TEST NO. 11.—DEEP BALLAST TANKS, IF USED FOR FUEL OIL

(*a*) *Object*

To test the oiltightness and strength of the boundary

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bulkheads, deck forming the crown of the tank, longitudinal divisional bulkheads (one at least on centerline is usually required), shell in way of tank, inner bottom in way of tank in double bottom vessels, all manholes, hatches, hatch covers and pipe connections to tank top, inner bottom, bulkheads or shell.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested with a head of water at least one foot above the highest point to which oil has access in the pipes (i. e., vent, overflow or filling lines), hatchways or elsewhere; or to a head of not less than eight feet above the highest point of the compartment, whichever is highest.

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline or twelve feet above the highest point of the compartment, whichever of these is the greater.

3. Bureau Veritas.

To be tested with a head of water extending to the upper deck, and at least thirteen feet above the crown of the tank.

(*c*) *Procedure of Testing*

Test before launching and before painting with bitumastic or cementing or cement washing and after all work within and adjacent to tank has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to launching date or other contingencies, the final approval of the test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory.

Fit a standpipe to the tank top (vent or filling line may be used) with a large funnel or other container at the top and at such a height that the level of the water at the required head will show in the container. No leaks or defects should develop at this head, and any found should be made good by legitimate means to the satisfaction of the surveyor. Often it is not possible to test completely before launching, and in this contingency it is necessary to have a preliminary test to insure the tightness of the shell in way of the tank. In this case the tank is filled with water to the level of the crown of the tank and the shell made tight to the satisfaction of the surveyor.

Since the tank is to carry oil, and in view of the fact that oil is more searching than water, the surveyor's inspection and test will usually be more rigid and a superior job insisted upon throughout.

TEST NO. 12.—FUEL OIL BUNKERS

(*a*) *Object*

To test the oiltightness and strength of the transverse and longitudinal boundary bulkheads, the deck forming the crown of the tank, the shell in way of the tank, the inner bottom in way of the tank in double bottom vessels, all manholes and hatches and pipe connections to the top, sides or bottom of the tank.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested with a head of water at least one foot above the highest point to which oil has access in pipes (i. e., vent, overflow or filling lines), hatchways or elsewhere; or to a head of not less than eight feet above the highest point of the compartment, whichever is highest.

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline or twelve feet above the highest point of the compartment, whichever of these is the greater.

3. Bureau Veritas.

To be tested with a head of water extending to the upper deck, and at least thirteen feet above the crown of the tank.

(*c*) *Procedure of Testing*

Test before launching and before painting with bitumastic or cementing or cement washing on outside, because, of course, no paint or coating of any kind will be used inside of tanks, and after all work within and adjacent to the tank has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to launching date or other contingencies, the final approval of the test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory.

Fit a standpipe to the tank top (vent or filling line may be used) with a large funnel or other container at the top and at such a height that the level of the water at the required head will show in the container. No leaks or defects should develop at this head, and any found should be made good by legitimate means to the satisfaction of the surveyor. Since the tank is to carry oil, and in view of the fact that oil is more searching than water, the suveyor's inspection and test will usually be more rigid and a superior job insisted upon throughout.

TEST NO. 13.—FUEL OIL SETTLING TANKS

Note.—This test only applies where the settling tanks form an integral part of the ship's structure and *not when the tanks are independent of the hull.*

(*a*) *Object*

To test the oiltightness and strength of the transverse and longitudinal boundary bulkheads, the deck forming the crown of the tank, the shell in way of the tank, the inner bottom in way of the tank in double bottom vessels, all manholes and hatches and pipe connections to the top, sides or bottom of the tank.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested with a head of water at least one foot above the highest point to which oil has access in pipes (i. e., vent, overflow or filling lines), hatchways or elsewhere; or to a head of not less than eight feet above the highest point of the compartment, whichever is highest.

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline or twelve feet above the highest point of the compartment, whichever of these is the greater.

3. Bureau Veritas.

To be tested with a head of water extending to the upper deck and at least thirteen feet above the crown of the tank.

(*c*) *Procedure of Testing*

Test before launching and before painting with bitu-

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manship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to some contingency, the final approval of test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory.

Fit a standpipe onto tank top (vent or filling connection may be used) and carry the pipe to the prescribed height fitting a large funnel or other container at the top, the height of which is to be such as to show the level of the water when at the testing head. No leaks or defects should develop at this pressure, and any found should of course be made good by legitimate means to the satisfaction of the surveyor. Often it is not possible to test completely before launching, and in this contingency it is necessary to have a preliminary test to insure the tightness of the shell in way of tank. In this case the tank is filled with water to the level of the crown of the tank and the shell is made tight to the satisfaction of the surveyor.

Since the tank is to carry oil, and in view of the fact that oil is more searching than water, the surveyor's inspection and test will usually be more rigid and a superior job will be insisted upon throughout.

TEST NO. 9.—AFTER PEAK TANK, IF USED FOR FUEL OIL

(*a*) *Object*

To test oiltightness and strength of peak bulkhead, shell in way of tank, deck forming crown of tank, manholes, hatches and pipe connections to bulkhead, tank top or shell.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested with a head of water at least one foot above the highest point to which oil has access in pipes (vent, overflow of filling lines) hatchways or elsewhere; or to a head of not less than eight feet above the highest point of the compartment, whichever is highest.

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline or twelve feet above the highest point of the compartment, whichever of these is the greater. In the 1920 edition of Lloyd's Rules the requirements of 12 feet above the load waterline has been modified to read to load waterline. The alternative requirements, however, are unchanged.

3. Bureau Veritas.

To be tested with a head of water extending to the upper deck, and at least thirteen feet above the crown of the tank.

(*c*) *Procedure of Testing*

Test before launching and before painting or coating with bitumastic and after all work within and adjacent to the tank has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to some contingency, the final approval of test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory.

Fit a standpipe onto the tank top (vent or filling connections may be used) and carry the pipe to the prescribed height, fitting a large funnel or other container at the top, the height of which is to be such as to show the level of the water when at the testing head. No leaks or defects should develop at this pressure, and any found should of course be made good by legitimate means to the satisfaction of the surveyor. Often it is not possible to test completely before launching, and in this contingency it is necessary to have a preliminary test to insure the tightness of the shell in way of tank. In this case the tank is filled with water to the level of crown of the tank and the shell made tight to the satisfaction of the surveyor.

Since the tank is to carry oil, and in view of the fact that oil is more searching than water, the surveyor's inspection and test will usually be more rigid and a superior job will be insisted upon throughout.

TEST NO. 10.—DOUBLE BOTTOM TANKS, IF USED FOR FUEL OIL

(*a*) *Object*

To test oiltightness of shell plating in way of double bottom tank top plating, and margin plate strength and tightness of watertight floors and centerline division plating (centerline girder), manholes and pipe connections to tank top, watertight floors, centerline girder or to shell.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested before launching with a head of water at least one foot above the highest point to which oil has access to pipes, i. e., (filling vent or overflow pipes).

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline.

3. Bureau Veritas.

To be tested before launching with a head of water extending to the upper deck.

(*c*) *Procedure of Testing*

Test before launching and before painting with bitumastic or cementing or cement washing, and after all work within and adjacent to the tank has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to launching date or other contingencies, the final approval of the test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory. Each tank is to be tested separately so all sides of divisional floors or girders such as watertight centerline girder may be observed.

Fit a standpipe to the tank top (vent or filling line may be used) with a large funnel or other container at the top and at such a height that the level of the water at the required head will show in the container. No leaks or defects should develop at this head, and any found should be made good by legitimate means to the satisfaction of the surveyor.

Since these tanks are to carry oil, and in view of the fact that oil is more searching than water, the surveyor's inspection and test will usually be more rigid and a superior job will be insisted upon throughout.

TEST NO. 11.—DEEP BALLAST TANKS, IF USED FOR FUEL OIL

(*a*) *Object*

To test the oiltightness and strength of the boundary

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bulkheads, deck forming the crown of the tank, longitudinal divisional bulkheads (one at least on centerline is usually required), shell in way of tank, inner bottom in way of tank in double bottom vessels, all manholes, hatches, hatch covers and pipe connections to tank top, inner bottom, bulkheads or shell.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested with a head of water at least one foot above the highest point to which oil has access in the pipes (i. e., vent, overflow or filling lines), hatchways or elsewhere; or to a head of not less than eight feet above the highest point of the compartment, whichever is highest.

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline or twelve feet above the highest point of the compartment, whichever of these is the greater.

3. Bureau Veritas.

To be tested with a head of water extending to the upper deck, and at least thirteen feet above the crown of the tank.

(*c*) *Procedure of Testing*

Test before launching and before painting with bitumastic or cementing or cement washing and after all work within and adjacent to tank has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to launching date or other contingencies, the final approval of the test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory.

Fit a standpipe to the tank top (vent or filling line may be used) with a large funnel or other container at the top and at such a height that the level of the water at the required head will show in the container. No leaks or defects should develop at this head, and any found should be made good by legitimate means to the satisfaction of the surveyor. Often it is not possible to test completely before launching, and in this contingency it is necessary to have a preliminary test to insure the tightness of the shell in way of the tank. In this case the tank is filled with water to the level of the crown of the tank and the shell made tight to the satisfaction of the surveyor.

Since the tank is to carry oil, and in view of the fact that oil is more searching than water, the surveyor's inspection and test will usually be more rigid and a superior job insisted upon throughout.

TEST NO. 12.—FUEL OIL BUNKERS

(*a*) *Object*

To test the oiltightness and strength of the transverse and longitudinal boundary bulkheads, the deck forming the crown of the tank, the shell in way of the tank, the inner bottom in way of the tank in double bottom vessels, all manholes and hatches and pipe connections to the top, sides or bottom of the tank.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested with a head of water at least one foot above the highest point to which oil has access in pipes (i. e., vent, overflow or filling lines), hatchways or elsewhere; or to a head of not less than eight feet above the highest point of the compartment, whichever is highest.

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline or twelve feet above the highest point of the compartment, whichever of these is the greater.

3. Bureau Veritas.

To be tested with a head of water extending to the upper deck, and at least thirteen feet above the crown of the tank.

(*c*) *Procedure of Testing*

Test before launching and before painting with bitumastic or cementing or cement washing on outside, because, of course, no paint or coating of any kind will be used inside of tanks, and after all work within and adjacent to the tank has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to launching date or other contingencies, the final approval of the test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory.

Fit a standpipe to the tank top (vent or filling line may be used) with a large funnel or other container at the top and at such a height that the level of the water at the required head will show in the container. No leaks or defects should develop at this head, and any found should be made good by legitimate means to the satisfaction of the surveyor. Since the tank is to carry oil, and in view of the fact that oil is more searching than water, the suveyor's inspection and test will usually be more rigid and a superior job insisted upon throughout.

TEST NO. 13.—FUEL OIL SETTLING TANKS

Note.—This test only applies where the settling tanks form an integral part of the ship's structure and *not when the tanks are independent of the hull.*

(*a*) *Object*

To test the oiltightness and strength of the transverse and longitudinal boundary bulkheads, the deck forming the crown of the tank, the shell in way of the tank, the inner bottom in way of the tank in double bottom vessels, all manholes and hatches and pipe connections to the top, sides or bottom of the tank.

(*b*) *Classification Societies' Rules*

1. American Bureau of Shipping and British Corporation Registry.

To be tested with a head of water at least one foot above the highest point to which oil has access in pipes (i. e., vent, overflow or filling lines), hatchways or elsewhere; or to a head of not less than eight feet above the highest point of the compartment, whichever is highest.

2. British Lloyd's Register.

To be tested with a head of water extending to the highest point of the filling pipes or twelve feet above the load waterline or twelve feet above the highest point of the compartment, whichever of these is the greater.

3. Bureau Veritas.

To be tested with a head of water extending to the upper deck and at least thirteen feet above the crown of the tank.

(*c*) *Procedure of Testing*

Test before launching and before painting with bitu-

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mastic or cementing or cement washing on outside of tank, because, of course, no paint or coating of any kind will be applied inside of the tank, and after all work within and adjacent to the tank has been completed and the workmanship has been inspected and passed by the surveyor. If it is necessary to test before the surveyor has inspected the workmanship, due to launching date or other contingencies, the final approval of the test cannot be given until such workmanship has been passed. Any finding of the inspector which makes necessary work which may affect the tightness of the structure will make a re-test obligatory.

Fit a standpipe to the tank top (vent or filling line may be used) with a large funnel or other container at the top and at such a height that the level of the water at the

Graphic Illustration of Extensive Use of Oxy-Acetylene in Shipyards

THE arrangement of the Toledo Shipbuilding Company's yards at Toledo, Ohio, shown in Fig. 1, is interesting not only on account of the unique arrangement of the launching ways alongside the company's dry docks into which the vessels are launched sideways, but also because it affords a graphic illustration of the extent to which the use of oxy-acetylene enters into present-day shipbuilding. This yard is one of the most extensive users of oxy-acetylene in the Great Lakes district and is a model in equipment.

The Toledo yard makes its own acetylene, operating a 500-pound duplex generator which supplies its distribu-

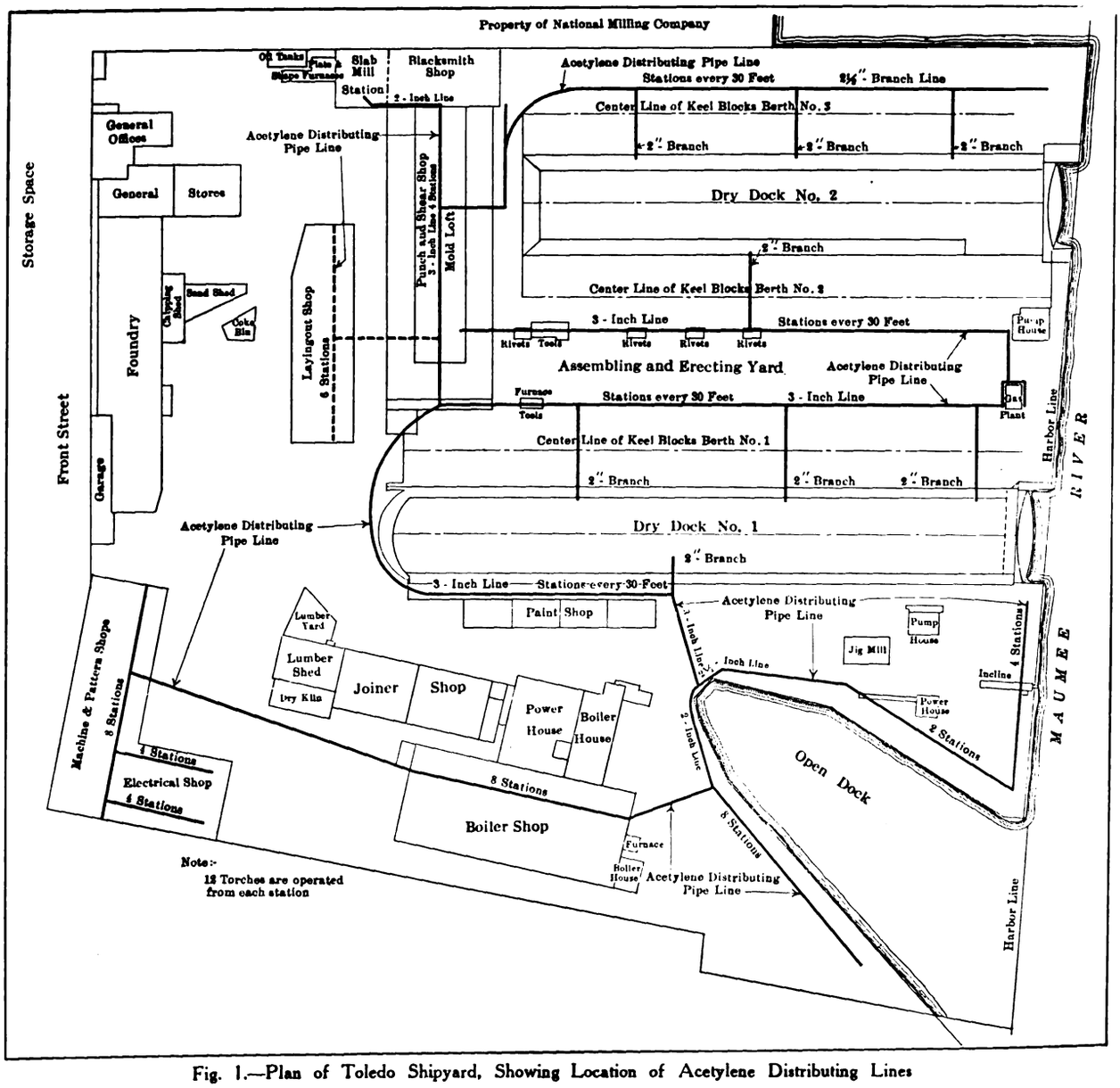

Fig. 1.—Plan of Toledo Shipyard, Showing Location of Acetylene Distributing Lines

required head will show in the container. No leaks or defects should develop at this head, and any found should be made good by legitimate means to the satisfaction of the surveyor. Since the tank is to carry oil, and in view of the fact that oil is more searching than water, the surveyor's inspection and test will usually be more rigid and a superior job insisted upon throughout.

(To be concluded.)

ting system, but it is none the less a fair illustration of the general use of oxy-acetylene in yards that purchase dissolved acetylene gas in cylinders. In fact, acetylene gas is supplied in cylinders at this yard wherever there is need for acetylene at any distance from the stations. Liquid air oxygen is used exclusively.

The following table gives the number and location of welding and cutting stations shown in the drawing:

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LOCATION AND NUMBER OF WELDING AND CUTTING STATIONS

Building Berth No. 1	22
Building Berth No. 2	18
Building Berth No. 3	18
Dry Dock No. 1	4
Dry Dock No. 2	4
Around Open Dock	22
Boiler Shop	8
Slab Mill	1
Punch and Shear Shop	4
Laying Out Shop	6
Pipe Line Shop	4
Sheet Metal Shop	4
Machine Shop	8
Total Number of Stations	115*

The use of oxy-acetylene in the Toledo Shipbuilding Company's yard has been an interesting development, growing steadily with the expansion of the range of applications authorized by the American Bureau of Shipping as rapidly as they were found suited to the work done in this plant. Today these applications constitute an imposing list, including the following items:

Welding.—Deck rail stanchions to plating; clips for detachable rail stanchions; skylights over galley; engine room stairs and gratings; boiler room stairs and gratings; all stairs and ladders, including all rail attachments; door frames to casing, hinges, catch hold coach hooks, etc.; coal chutes; engine room skylights; corners on water tanks; heads in water and filter tanks; framing and supports for engine and boiler room flooring or grating; cargo batten cleats; tanks that are not structural parts; shaft alley escapes; wash plates.

Cutting.—Cutting off all frames; cutting of all angles used on boat; cutting headlights and manholes; cutting inside circle on all plates or all irregular shapes that can be sheared; cutting all scrap.

Repairs.—Heating and straightening braces and machine repair.

* Twelve torches may be used at each station.

Anti-Noise Marine Telephone Inter-Communication Systems

IT is essential in the operation of a vessel that the source of communication between the bridge, main engine room and steering engine room be absolutely reliable. Two means of communication are possible, the engine telegraph, by which the engine signals are transmitted from the bridge to the engineer, or some method of voice transmission. In an emergency, this latter is very essential, for a word or two from the captain to the engineer might prevent serious damage to the vessel.

With the slow-moving reciprocating engine and hand-fired boilers the noise in the fireroom and engine room is not of such volume as to interfere to any extent with the voice tube method of communication, but in the great majority of ships, with the noise of the reduction gears of high-speed turbines and the roar of oil burners, this method is practically useless.

In studying the requirements of inter-communication systems, it was first thought that a very loud-speaking telephone would solve the difficulty, so a system of this type was developed and installed in many ships. It did not, however, overcome the noise conditions, for the roar in the engine room made it almost impossible to understand orders from the bridge. On the bridge itself, the noise is nearly as great as in the engine room, caused by the whistling of the wind through the rigging, seas breaking over the bow, the running of deck winches and the thousand and one other noises accompanying the operation of a ship. After exhaustive trials, it was decided that although the loud-speaking instrument was satisfactory in quiet surroundings it did not fill the requirements for intercommunication aboard ship.

A final solution of the problem came in the development of intercommunication telephones for use on the seaplanes of the United States Navy by the Magnavox Company, Oakland, Cal. The problem here was really worse than on board ship, for it would be difficult to imagine a noisier place than the cockpit of a flying boat, with the rush of the wind between the planes and the roar of unmuffled, high-powered motors. As soon as war restrictions were removed the device was adapted to marine

Anti-Noise Marine Telephone in Use

service, being installed on merchant vessels, passenger liners, oil tankers and also on the latest type destroyers.

The apparatus has been given the name Magnavox anti-noise telephone for the reason that a simple, balanced diaphragm transmitter eliminates noises from outside sources. The diaphragm is exposed both back and front, so that all noises strike the diaphragm with equal force on both sides. Under this condition, it is claimed, there is no vibration of the diaphragm, the electrical circuit remains undisturbed, and nothing is transmitted over the wire. When speaking directly into the instrument, however, vibrations on one side of the diaphragm are intensified and the electrical impulses set up by the vibrations are reproduced at the other end of the line. At this point the receiver is of the electro-dynamic type, which reproduces the voice clearly and slightly amplified.

The apparatus is arranged in various systems so that it is possible to call any part of the ship from the master station, or to call the master station from the sub-station. With slight alterations the sub-stations may call each other through connections made by means of selective control switches.

Shipbuilding Returns

The Bureau of Navigation, Department of Commerce, reports 164 sailing, steam, gas and unrigged vessels of 251,442 gross tons built in the United States and officially numbered during the month of April, 1920. About three-quarters of this tonnage consists of vessels owned by the United States Shipping Board. From other sources than construction ten vessels of 34,633 gross tons were admitted to American registry.

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The American Bureau of Shipping

IT was to be expected that the action of the Shipping Board, in ordering its managers and operators to have all vessels owned by the Board classed by the American Bureau of Shipping, would receive more or less adverse criticism in Great Britain. Now that the new Merchant Marine Act has gone still further in directing that all departments, boards, bureaus and commissions of the government are to recognize the American Bureau of Shipping as their agency, there will probably be many predictions of disaster to our shipping industry from English sources.

If the statement made by one British paper "that American vessels, when they carry the prestige of Lloyd's Registry, are often insured on practically the same terms as British-built vessels, although the risks can not be considered equal in quality" is true, then we are certainly under deep obligations to that institution. It is a fact, however, that a large number of vessels have been designed, built and classified to the rules of the American Bureau and that these vessels have proved themselves to be seaworthy in every respect. Going still further, the Navy Department has succeeded in designing and building its war vessels without the aid of any classification society and no one will venture to say that these vessels have not given a good account of themselves.

If we are able to build good vessels, it ought to be apparent that we should be able to survey them. A statement that "the ability of the Bureau's surveyors is an unknown quality" is an injustice because they are known to be men of long experience in shipbuilding and are recruited from the shipyards. As the position of surveyor is a desirable berth the Bureau has been able to secure men of more than average ability for this work.

One of our English contemporaries apparently believes that all vessels, whether private or government-owned, must be classified by the Bureau and that this work will be done free of charge. It says, "the fact that they are offering a certificate of classification by the Bureau free of cost, will probably result in the compliance of the American owners with the arbitrary order which has just been issued." The Government has no intention of compelling any owner to classify his vessel with the Bureau, it is simply setting the good example of patronizing an efficient American institution for this work and at the same time securing uniformity of classification for its vessels.

Passing to the question of construction rather than chartering or insurance, it is the belief of many that Lloyd's rules require heavier scantlings than are necessary for safety. The fact that Lloyd's classify longitudinally framed vessels of lighter weight than similar vessels having transverse frames, although the frames of the former type are cut and bracketed at the bulkheads, would indicate that the rules of the American Bureau, which lie between the types mentioned above, are more rational and economical as regards the weight of steel.

The Most Efficient Type of Vessel

ONE of the sections of our new Merchant Marine Act provides that "the Shipping Board may annually set aside for a period of five years, out of the revenue from sales and operations, a sum not exceeding $25,000,000, to be known as its constructive loan fund, to be used in the construction, or in aid of the construction, of vessels of the best and most efficient type and that such vessels shall be equipped with the most *modern*, the most *efficient* and the most *economical* machinery and commercial appliances."

The most efficient type of vessel will depend upon the requirements of the service for which it is designed. It is apparent that dimensions, characteristics and arrangement of holds and quarters, that are suitable for a proposed vessel, will depend on whether it is a freighter, tanker, passenger, combination or other type of vessel; whether it is a slow, medium or high speed vessel; what the character of the cargo or the number of passengers that it is designed to carry is, as well as on the depth of harbors and many other things.

Passing over the question of the best shape and structure for the hull, do the phrases "the most *modern*, the most *efficient* and the most *economical* machinery" mean that the framers of this section of the shipping bill had in mind a particular type of machinery to the exclusion of all others? While it would be difficult to get a representative committee of naval architects to agree on the best design for a particular class of vessel, what shall be said of the possibility of securing a decision from a committee of representative engineers as to whether the reciprocating engine, the turbine, the electric drive, the Diesel or hot bulb engine is at the same time "the most modern, the most efficient, and the most economical type of machinery?" A partial list of the items upon which

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such a decision would have to be based is as follows, viz.: the fuel consumption for installations of similar power including the *auxiliaries;* the comparative weights and the first cost; the volume, floor space and center of gravity of the installation; the vibration due to the inertia of reciprocating parts, liability of breaking down or stopping, ability to operate over a large power range without serious loss in economy; adaptability to low, medium and high speeds; the available supply of skilled men competent to handle the type of machinery selected, etc.

The Shipping Board should be in a position to gather some very valuable data on the relative economy of turbines and reciprocating engines. If this data can be supplemented by some information on similar vessels running under similar conditions powered with the Diesel engine direct connected, the Diesel engine with electric drive and the turbine with electric drive, a practical answer as to the best machinery for a given type of vessel may be obtained.

The Screw Propeller

WHEN the screw propeller was first used to drive ships, the engines were slow and the ships were slow, and conditions led to the use of a large propeller with a large pitch ratio such as one and a half. This was fortunate, as it aided in the introduction of the device. Seamen and all others connected with navigation are naturally conservative and, having a good thing, are likely to stick to it. In early days there was a tendency for the screw to get ahead of the engine, and geared engines were used in some cases—for example, on the *Wampanoag* built shortly after the Civil War. In that case the screw ran faster than the engine. To reduce shock and lessen noise, the gear wheel had wooden teeth, while the pinions were of cast iron, chipped and filed. This ship made an unusual speed of sixteen knots by the log and burned forty tons of coal a day.

When high speed was desired, especially for relatively small ships, the engines were speeded up and the screws had a smaller diameter and a smaller pitch ratio and ran with greater slip. The loss of economy was accepted as a penalty of high speed. The most notable development along the line occurred on torpedo boats and on destroyers.

But when steam turbines were applied to navigation, incompatible conditions gave trouble at once. The steam turbine is essentially a high speed machine and the screw propeller gives a good efficiency only when it has sufficient diameter and a large pitch ratio. Parsons, who first applied steam turbines on shipboard, went to the limit at both ends to join the turbine and propeller on the same shaft. He used turbines with many stages, and led the steam from turbine to turbine on two or three shafts. Other turbines are somewhat easier to adapt to ship propulsion, but all suffer from the same difficulty. Only high speed ships, large or small, can use direct connected steam turbines advantageously.

Parsons was the first to find the remedy, namely, the introduction of gearing, which for cargo ships is compounded.

When Diesel engines had won their way on shipboard, it was evident that high rotative speed was desirable to reduce the weight and cost of the engine; in this case the poorer efficiency of smaller screws, with a smaller pitch ratio, is accepted the more easily as the fuel economy is good. The internal combustion engine is not well adapted to driving through gearing.

Emmet's electric drive, as applied to battleships and battle cruisers, among its many advantages can drive the screw at the speed best adapted for economy. These types of ships have high speed and give excellent results with electric propulsion. Ships that have relatively low speed can be driven by this method, but the motors could be smaller and more efficient, if the speed of the screw could be increased.

The information for a discussion of the effect in practice of using higher speed screws with smaller pitch ratios is not in form for presentation at this time, if, indeed, it is in existence. Fortunately, we have in the diagram presented by Admiral Taylor means of looking into this question. There may be some uncertainty when model experiments are applied to full-sized propellers, but we may be sure that experiments give correct *relative* information; those conditions which give good results for models will give good results for ships. Across each diagram of properties of propellers Admiral Taylor draws an optimum line, which allows the designer to select those proportions that will give the best efficiency for his conditions. In a particular case this line shows the best economy at a pitch ratio of 1.6 and a real slip, allowing for wake of 14 percent. If the pitch ratio be reduced to unity, the slip increases to 26 percent and the efficiency falls from 74 percent to 65 percent. For once the conservatism of the seaman seems to be well founded.

Shipbuilding

IN view of the fact that the Shipping Board has requested the Interstate Commerce Commission to suspend the operation of the preferential export rates for American vessels for ninety days on the grounds that there would probably not be enough ships to handle our exports, is it not essential that immediate action should be taken to secure the required American tonnage? Although each succeeding month has seen an increase in the tonnage under construction for private account, this increase has not been sufficient to compensate for the completion of Shipping Board vessels and the total of the government and private tonnage has decreased.

Now that the Merchant Marine Act has provided for the expenditure of $25,000,000 annually for the next five years to aid the construction of new vessels, has exempted shipowners from the payment of war and excess profit taxes, providing the money is spent in building new vessels, and has in many other ways provided for the welfare of our merchant marine, it is up to us to keep our shipyards busy.

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LETTERS TO THE EDITOR

Deflection of Concrete Ships

In the current issue of MARINE ENGINEERING, under "Questions and Answers for Marine Engineers," I notice a statement that "no tests have been made to the writer's knowledge upon the deflection of concrete ships."

Although, unfortunately, I have no experience under sea-going conditions to relate, I have made observations on three concrete vessels on launching. These boats were 125 feet long and with sights arranged about 112 feet apart no deflection was observed. A steel vessel under similar conditions would probably have a deflection of 3/16 inch or so.

Bethlehem, Pa. GEORGE B. STOREY.

[For further information regarding tests on the deflection of concrete ships, readers are referred to the article on "The Strainagraph and Its Application to Concrete Ships," page 588 of this issue.—THE EDITORS.]

Ship's Fire Detection System Performs an Unexpected Task

The crew of the *Leviathan* tell many stories, humorous and otherwise, of their experiences during the many months that vessel was occupied in transporting American troops to and from France. One of their lesser hardships involved their troubles in finding some out-of-the-way nook for their quiet daily smokes, for no smoking was allowed on board.

In one of the lower holds a number of the crew were gathered one evening for a quiet, undetected smoke. But their plans were foiled, and the men, it is supposed, were temporarily reformed by an odd accident. The ship's fire detection system was based on the principle of locating incipient fires by catching traces of smoke which are conveyed through pipe lines to the wheel house. Here, on that particular evening, the officer on duty not only distinctly caught the tobacco odor, but was able by noting the faint wisps of smoke in the fire detecting cabinet to locate the hold, and the men were "caught in the act."

Thereafter when the men sought a hold for their smoking parties they were careful to detail several men to see that each of the smoke collectors in the hold was carefully and completely stopped up with socks, blouses and odd pieces of wearing apparel.

New York. F. S. TITSWORTH.

Stop the Waste of Fuel Oil

In spite of the repeated requests for conservation of fuel oil due to the constantly increasing demand and the diminishing supply in this country, there is a great waste of this, our most desirable fuel, in the marine boiler plants.

Large numbers of ships lie at anchor in Hampton Roads and at the piers of Portsmouth, Norfolk and Newport News with an excessive and wasteful amount of smoke coming from their stacks. In fact, on some days for hours at a time in the vicinity of the piers adjacent to the Navy Yard at Portsmouth, Va., the smoke from vessels clouds the sky over that section of the city. This condition, which no doubt exists in other ports and also while the ships are at sea, shows that many barrels of oil are being needlessly wasted.

The reasons for this waste are many and can be divided into two classes; first, those due to inefficient boilers, blowers and oil burning outfits, and, second, those due to the lack of experienced operators for the plants. The first class can be considerably reduced by the builders of the ships and the manufacturers of the oil burning apparatus, who should give this subject more attention and make greater efforts to increase the efficiency of their boilers, burners and auxiliaries. The other conditions can be improved by the supervising engineers, who should give more attention to the training of their boiler room personnel. The fact that a great many oil burning ships can steam efficiently and without excessive smoke when in port as well as when at sea shows that the losses of the remaining ships can be materially reduced.

Another source of waste is the large amount of oil that is pumped overboard from oil burning ships. This is not only an economic waste, but it has become a source of annoyance in the harbors and at the bathing beaches. Part of it is due to leaks from the oil systems into the bilges and part to the lack of care in pumping water and sediment from the bottoms of tanks. Both of these wasteful conditions can be almost eliminated with a little care by the operating force.

The conservation of fuel oil should be given careful consideration by all concerned in its use and every effort made to obtain the greatest amount of power that is possible from each pound.

Norfolk, Va. J. M. MOORE.

Piecework in British Shipyards

The important subject of piecework in British shipyards is now being seriously discussed by ship constructors' and shipwrights' associations in several British shipbuilding centers. It is recognized that piecework is a possible alternative to the system hitherto in vogue.

In a circular recently published on the subject, after describing the position of the shipwrights since the end of 1919, it is stated that while the berths were enormously increased there was a smaller number of men to cope with the work; also that several districts had adopted piecework since the armistice (November, 1918). The circular states that piecework is now pretty general through the area of the ship constructors' and the shipwrights' associations and draws special attention to the fact that the Federation of Unskilled Men's Unions has also accepted the system of payment by results. At a conference held a few weeks ago between masters and men, the following working conditions were provisionally adopted:

(1) That piecework in the shipwrights' trade is needed in order to cope with the present position in the shipbuilding industry, and it may be assumed that the system will not result in unemployment. In the event of the work slacking off, and should any unemployment result therefrom, the shipwrights reserve to themselves the right to revert to the system in operation prior to the war; they will, however, give reasonable notice to the employers before doing so.

(2) The employers state that they are desirous that in their yards where the piecework system has been adopted there be an equitable distribution of piecework and that every effort will be made to maintain only a minimum number of men on time; in order to be able to do so, the employers' association will recommend its members to fix up prices wherever possible to cover unlisted or obstructed work; moreover, reasonable allowance shall be made in cases where men are adversely affected by unforeseen and unusual obstructions.

The men's circular states, as regards clause (1) quoted above, that it absolutely guarantees the shipwrights

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against the fear of unemployment arising out of the system of piecework and that the men reserve to themselves the right, which is now recognized and accepted by the employers, to revert to the previous system after due notice should the occasion (that is, unemployment) arise. Clause (2) does away with any favoritism or any faddiness of the foreman and concedes a principle which has been the subject of strife for many years.

Manchester, England. T. SINGTON.

How Long Should a Vessel Stay in Port for Discharging and Loading Cargo?

Although it is of greater interest to know the necessary time for discharging and loading miscellaneous cargoes, yet the actual time consumed for bulk freight can also be of practical service, especially if representing a record of minimum time. The following figures are from official records:

For ore unloading on May 11, 1918, at Gary, Ind., 11,415 gross tons were taken out of the steamer *Wm. B. Dickson* in 4 hours 10 minutes, an average of 2,739 tons an hour.

On July 9-10, 1918, the steamer *G. G. Barnum,* with 10,610 net tons of coal, was unloaded, shifted to another dock and loaded with 9,767 tons of ore in 16 hours. During this time of 16 hours there were discharged and loaded 21,549 net tons of freight.

The minimum average time spent in the upper and lower Great Lakes ports by one fleet of ships will indicate what has been done in 1918: Average time spent in port receiving and discharging cargoes at upper and lower lake ports, 31 hours 26 minutes; average cargo, 8,498 gross tons; largest cargo carried, 13,505 gross tons; fastest loading record, 12,655 gross tons in 1 hour 50 minutes; fastest rate per hour, 6,903 gross tons.

The figures in general apply to loading and discharging coal and then loading and discharging iron ore. Until the official records were made the possibility was doubtful.

For miscellaneous cargoes, utilizing the combined gantry cranes and ships' winches for transferring between vessel and shore and overhead conveyors to secure a steady flow of the cargoes through the transit sheds, including assorting, distributing and tiering, it should be possible to attain far superior results than have been possible in the past.

The later method of operation has been for the ships' winches, at least two winches at each hatch, preferably four, to raise the draft from between decks and then above the upper deck, when the load is burtoned to the hook of the gantry crane (there should be two cranes operating at each hatch), and then swung just within the shed. With five hatches to a ship there would be ten winches and ten cranes operating simultaneously.

As sixty drafts per hour can be raised from each hatch, and averaging one ton per draft per consignment, then from five hatches there should be not less than 300 tons per hour, or in ten hours three thousand tons per day in discharging. This is possible, as the cycle of the winches and of the cranes is less than if there was not a division of the work.

For miscellaneous cargoes the flow through the shed is kept continually moving without congestion. This is effected by a combination of overhead traveling cranes and overhead traveling hoists. The number of traveling hoists is proportioned to the volume of the freight and to the number of consignments. To discharge a ship of an average capacity of 4,500 tons would require only fifteen hours.

For loading the ship the gantry crane swings the load to the bottom of the hold or to the required deck and the function of the ship's winch is to drag it to its stowage place between decks. This is far below the figures for handling bulk freight, which can probably never be equalled when handling miscellaneous freight.

More freight can be loaded than discharged in the same time, and 375 tons per hour are here possible, especially if there are more winches. This freight, however, must be brought by the overhead internal crane machinery to within reach of the hook of the gantry crane, so that there may be no waiting or congestion points.

To discharge 4,500 tons of miscellaneous freight would require twelve hours. It would, however, be better to have three shifts of eight hours each, and then the ships would be discharged in about two shifts and in one and one-half shifts.

If there could be four winches to a hatch, then additional speed could be secured by discharging upon or loading from lighters. The freight movements would be upon both sides of the ship simultaneously.

The bunkering or the taking on of the fuel oil can be done during the transferring of the cargo.

Four thousand five hundred tons inbound and 4,500 tons outbound should require a little less than 30 hours for discharging and for loading, repairs to be performed as usual during this time.

The above figures are possible but require a high efficiency of the winches and cranes and no congestion or interruption of the flow of the freight. There is not sufficient floor area alongside the ship, and overhead unoccupied air spaces must be utilized. It is only by careful designing of all the terminal elements and a complete co-ordination of all the movements of the freight by mechanical appliances that such results can be attained. One congestion point will greatly reduce the above figures.

New York. H. McL. HARDING,
Consulting Terminal Engineer.

British Committee on Inland Waterways

The Minister of Transport of Great Britain announces the appointment of the following committee on inland waterways: Neville Chamberlain, M. P., chairman; W. M. Acworth; R. B. Dunwoody, O. B. E., A. M. Inst. C. E., F. R. G. S.; Sir John E. Eaglesome, K. C. M. G.; Sir Noel T. Kershaw, K. C. B.; C. F. H. Leslie; Sir Halford J. Mackinder, M. P., and Arthur Sharp, secretary.

This committee is to investigate the following questions:

(1) What portions, if any, of the inland waterway system of the country should be acquired by the Ministry of Transport with a view to improvement and upon what terms?

(2) What should be the form of ownership of such acquired portions: whether under the State, through a department of the Ministry of Transport, or through a regional trust or by any other method? If a trust be recommended, what should be its constitution and the nature of its governing body?

(3) What improvement should be carried out in such acquired portions? What would be the cost of the improvement and how should the necessary funds be raised? Whether such acquired or improved portions would become self-supporting, and if not, what deficit would be involved; also what indirect advantage would be obtained to compensate therefor?

(4) What method should be adopted to ensure that any improvement in the value of the frontages should be secured in part at least to the body carrying out the improvement to the waterway?

(5) In what manner could co-operation best be developed between transport by water and transport by rail or road?

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NEW BOOKS

Naval Architects' Data

REVIEWED BY C. H. PEABODY, DR. ENG.

NAVAL ARCHITECTS' DATA. By J. Mitchell, M. I. N. A. Edited by E. L. Attwood, O. B. E., M. I. N. A. Size, 5½ by 8½ inches. Pages, 224. New York, 1919: Longmans, Green & Company. Price, $3.

This book provides printed forms for recording data for fifty ships.

The author is a shipyard manager and the editor is a well-known writer on naval architecture. Working together they have made a convenient form for recording data. They provide also the proper constants, factors and methods of computation and apply them to a particular case. At the back of the book are convenient tables of logarithms, squares, cubes and roots and areas of circles. Perhaps in a later edition they may find it possible to make a loose-leaf book, with provision for making changes and rearrangements.

Ship Stability and Trim

REVIEWED BY C. H. PEABODY, DR. ENG.

SHIP STABILITY AND TRIM. By Percy A. Hillhouse, B. Sc., M. I. N. A. Size, 5½ by 8½ inches. Pages, 297. Illustrations, 203. New York, 1919: D. Van Nostrand Company. Price, $4.50.

The author gives as the object of this book the presentation of the problems of stability of a ship more freely than is possible in any general text-book on naval architecture, and at the same time more simply than those books, avoiding mathematical methods. He hopes to meet the needs of those preparing for examinations for masters by the British Board of Trade. He says that if the master of every vessel were to make a point of carefully estimating the stability of his vessel at the beginning, during and at the end of every voyage, of utilizing this information as a guide to the correct use or avoidance of water ballast, and if he also habitually studied the behavior of his vessel at sea in the light of his knowledge of her stability factors, he would very quickly amass a quantity of data which would be a valuable aid to himself in the handling of his vessel, and of great use to the builders when projecting a new vessel for the same or a similar service. Many shipmasters have for years been in the habit of making such calculations. Also attention is called to the necessity that the master should note and correctly interpret the signs of decreasing stability, due to consumption of fuel or otherwise, as shown by inclination due to wind pressure or by slowing and sluggishness of rolling.

It is most encouraging to know that some shipmasters have such ability and use it; it is unquestionably desirable that all masters of modern ships should have the ability to apprehend the main features of stability and their relation to the movements of the ship. The author is correct in his opinion that abstruse and academic investigations are not for a shipmaster; in fact, we may go further and say that if he knows the properties and phenomena as facts he need not too much concern himself with the geometrical principles behind them.

It may be desirable to have a book presenting the facts concerning stability and rolling of ships simply and even dogmatically; it is certain that such a book has not been written. A shipmaster of studious habit may inform himself on these matters from any one of the simpler books on theoretical naval architecture; perhaps this book may be useful for that purpose, but it appears to contain much that is not needed by the shipmaster, and it is feared that certain parts may even be confusing.

Like almost all British writers on stability, the author endeavors to lead up to the stability of a ship by dealing first with simpler forms like cylinders and prisms; but the essential features of stability of a ship can be simply and clearly shown without such an introduction; in fact, we advise the reader of this book to omit the preliminaries and turn at once to the discussion for a ship which is stated clearly enough.

The most interesting chapters of the book are those on the effect of wind pressure and of trim during docking. Both are clearly and directly stated. The first is interesting to the shipmaster, especially if he chances to command a high-sided tender ship. But docking is the province of the dockmaster, and is equally interesting to the naval architect. Perhaps, however, the master of a ship may sometimes need to look after docking, especially in remote quarters of the earth.

In his chapter on free water in the ship, the author calls attention to the danger that may come from flooding side compartments, whether side bunkers or oil tanks. It is unlikely that flooding such a compartment will immediately capsize a ship, but the stability after the flooding may be dangerously small and especially the range of stability may be meager. The author also gives with some particularity methods of determining the position of the center of gravity by aid of an inclining experiment, together with examples in detail.

Hydrography

PHYSICAL LAWS UNDERLYING THE SCALE OF A SOUNDING TUBE. By Walter D. Lambert. Size, 5¾ by 9 inches. Pages, 45. Illustrations, 2. Washington, D. C., 1920: Government Printing Office. Price, 5 cents.

The use of the sounding tube or depth recorder has long been recognized as a convenient and rapid method for getting approximate soundings in depths of 100 fathoms or less. It has never been an instrument for accurate surveying and, indeed, the depths shown by two tubes of different patterns, thrown overboard at the same point, or even by two tubes of the same pattern, have often exhibited surprising discrepancies. The larger discrepancies must be due to some accident in the working of the apparatus, but the smaller ones may be due to the different assumptions made in laying off the scale of depths used. Moreover, it does not appear that the method of graduating the tubes now on the market has ever been published in detail.

It is the purpose of this paper: (1) to provide, with the information at hand, as correct a scale as possible for the tubes of the new Coast and Geodetic Survey pattern; (2) to give a method for correcting the depths read directly from the scale for variation in temperature and in atmospheric pressure; (3) to provide a compilation of physical data likely to prove convenient in a further study of the subject.

An approximate formula is first derived and corrections are given for the departure of the air from a perfect gas and for the vapor pressure and the compressibility of water; the final formula is put in a convenient form for computing tables from it. The tables at the end contain a compilation of data on the physical properties of air and sea water. The use of some of the tables is illustrated by numerical examples.

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

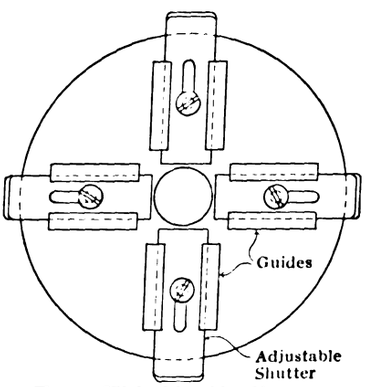
This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Locating Shafting Line

Q. (1047).—Will you kindly describe the best method of setting line for boring out stern frame for tube, also checking up the sag in line. B. F.

A. (1047).—There are several methods of setting up mark for boring out the stern frame for stern tube. One method, in which an engineer's level was used, is very clearly described by Mr. T. A. Johnson in MARINE ENGINEERING, April, 1920, page 378.

The use of the line of sight method (ray of light) is described in "Engine Room Practice" by John G. Liversedge. Briefly, it consists of a light with a reflector placed ahead of the main engine location, and at the proposed height of the shafting. At the forward end of the main engine a thin screen with a small hole (about 1/32 inch diameter) is placed, the hole being at the desired position of the shaft centerline. At the aft end of the stern post



Target With Movable Shutters

a similar screen should be fitted at the correct location of the shaft center. These two screens, with the holes in, together with the light, give a ray of light which defines the centerline of the shafting. To get any intermediate position of this centerline it is convenient to use a target having movable shutters (similar to the one in the figure) clamped to a temporary wooden upright set at the desired fore and aft place. The work of sighting and finding the position of the shaft center can best be done at night with any extra lights curtained off.

If a steel wire is used it will be necessary to allow for its sag, which for great distances may be considerable. A table for the sag of a piano wire of different spans and at various points is given in *The American Machinists' Handbook* (1914 Edition, page 420). A description of an experiment to determine the sag, together with curves of same, is given in the *Journal of American Society of Marine Draftsmen*, October, 1914.

Substitution of Radial for Feathering Paddle Wheels

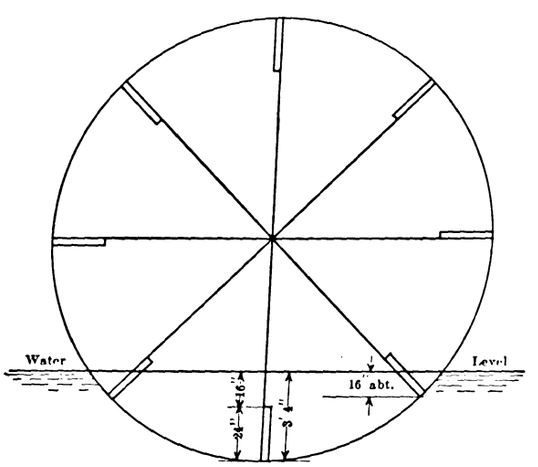
Q. (1050).—Can the speed of a ferryboat be improved by substituting a fixed type of bucket for the feathering type which it now has? The theory of the engineer is that there are not enough buckets in the water; also that the buckets run too far below the surface of the water, causing the engines to labor. His idea is to increase the number of buckets, reduce their width and "break step" in the buckets. By breaking step he means that each float or bucket will not run the full width of the wheel. Following is the data:

A side wheel ferryboat propelled by two 16-inch by 6-foot simple condensing engines making 31-32 revolutions per minute on 245 pounds steam, cutting off at 2 feet, or one-third stroke. Side wheels are 16 feet in diameter, each having eight buckets 6 feet long by 2 feet wide.

Three buckets only are in the water and their depth and position are explained in the sketch. The ferry is double ended. When the feathering mechanism is behind or opposite that in which the boat is running, the boat makes her best time. When it faces the direction in which the boat is running, it requires three minutes longer on a 15-minute trip. As the main shaft is just beneath the deck, it is not practicable to increase the diameter of the wheels, and vehicles forbid raising it above the deck. If the feathering mechanism were discarded, 16 inches or 18 inches could be added to the length of the buckets, making them 7 feet 4 inches or 7½ feet in length. Hence the two flexible factors in a wheel change seem to be the length of the buckets and their immersion.

When running, there is a slight rocking of the boat from side to side, which would indicate that the engines are laboring and that power is being absorbed uselessly in some sort of lifting action at the buckets during each revolution. What suggestion or solution would you offer to improve the problem? A. H. C.

A. (1050).—There appears to be but little data or information concerning feathering paddle wheel ferry steamers or radial paddle steamers. It would be well



Approximate Position of Floats on Feathering Paddle Wheel. Diameter of Wheel, 17 Feet; Each Float, 24 Inches Wide by 6 Feet Long; Draft of Boat, 4 Feet 10 Inches

perhaps first to consider whether the present installation is well proportioned for going ahead. You complain of laboring or vibration. This is likely to occur with the present wheels, as they do not have many blades compared to wheels of larger diameter. Below, the area, number of floats, dimension and immersion of blade for a feathering paddle wheel of this type have been worked out according to formulae from Seaton and Rounthwaite's *Pocketbook of Marine Engineering Rules and Tables*. An indicated horsepower of 400 and a slip of 20 percent have been assumed, as, unfortunately, your data do not give the ferry's speed, horsepower, molded dimensions, displacement, de-

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tails of feathering mechanism, and, further, there appears to be a mistake in the steam pressure given.

Area of one blade =

$$\frac{I.H.P.}{f-f^3} \times \left(\frac{83.2}{D \times R}\right)^3 = 14.23 \text{ square feet} \qquad (12.0)$$

$$\text{Number of floats} = \frac{D+2}{2} = \frac{15+2}{2} = 8.5 \qquad (8)$$

$$\text{Breadth of float} = \sqrt{\frac{A}{2.8}} = 2 \text{ feet } 3 \text{ inches} \qquad (2 \text{ feet})$$

$$\text{Length of float} = 2.85 \times \text{breadth} = 6 \text{ feet } 3 \text{ inches} \qquad (6 \text{ feet})$$

Immersion varies from 1/8 (breadth) = 3½ inches
to ½ (breadth) = 13½ inches
(16 inches)

where

D = diameter to float centers.
R = R. P. M.
$f = \frac{V-v}{V}$.
V = peripheral speed, feet per second, of wheel.
v = speed of ship, feet per second.
A = area of float.

The figures in the parentheses indicate the present feathering wheel dimensions. From the above you will see that the present wheel agrees reasonably well with correct proportions based on our assumptions for indicated horsepower, etc. The only improvement would be to decrease the vibration by increasing the number of blades and possibly to decrease the immersion slightly. Undoubtedly the use of radial wheels with the blades "breaking step," i. e., each blade to be only half the wheel length, would greatly reduce laboring or vibration.

The *Baystate* is an example of a vessel having both radial and feathering wheels during her existence. The feathering wheels were 22 feet 7 inches to centers of gudgeons and were driven at 20 revolutions per minute; the radial were 35 feet overall and turned up about 16 revolutions per minute (notice that the peripheral speed was about the same for each case). A few instances of ferries with both types of wheels are here given:

Ramona (see MARINE ENGINEERING, 1903, page 625)

Hull Dimensions.—Length overall, 130 feet; length between perpendiculars, 118 feet; beam (hull), 29 feet; beam (over guards), 49 feet; depth, 13 feet 9 inches.

Machinery.—Two cylinder, high pressure engine; 20 inches diameter by 72 inches stroke; indicated horsepower, 670; boiler pressure, 150 pounds; revolutions per minute, 35; speed, 12.5 knots.

Paddle Wheel (Radial Type).—17 feet diameter; 18 floats 18 inches wide, 6 feet long; immersed 12 inches.

Passenger Ferry (Data Approximate)

Hull Dimensions.—Length overall, 150 feet; beam (hull), 30 feet; beam (over guards), 50 feet.

Machinery.—Jet condensing beam engine with cylinder; 38 inches diameter by 96 inches stroke; indicated horsepower (nominal), 500; boiler pressure, 52 pounds.

Paddle Wheels (Break Step Type).—18 feet diameter; each half blade 4 feet 3 inches long; number of half blades = 2 × 14 each wheel; width of blade, 20 inches; immersion, 20 inches; speed, 9½ knots at 28 revolutions per minute and 39 pounds boiler pressure.

San Pedro (see MARINE ENGINEERING, 1911, page 345)

Hull.—Length between perpendiculars, 248 feet 6 inches; beam (hull), 36 feet.

Engine.—Inclined compound, 38 inches by 77 inches by 66 inches; indicated horsepower, 2,000.

Paddle Wheels (Feathering Type).—16 feet diameter to center of floats; number of blades, 8, each 3 feet 6 inches wide, 10 feet long.

Colonel Stevens, in MARINE ENGINEERING for 1897, refers to two feathering wheel ferries in use in New York harbor, the *Garrett* and *Winnan*, which had paddle wheels 17 feet in diameter, adjusted so that full advantage of the feathering principle was not taken (probably to allow for the poor efficiency when running astern).

The only published model experiments known to the writer on paddle wheels were those made at the instance of a committee of army engineers studying the question of river towboats. These are reported with numerous curves and interesting data in *Experimental Towboats*, House of Representatives Document 857. Many of the conclusions regarding these experiments as affecting feathering paddle wheels have been given in a paper by Professor E. M. Bragg before the Society of Naval Architects and Marine Engineers (1916). Some of their findings are here quoted:

"1. Thrust increases with immersion for any slip.
"2. Efficiency decreases rapidly with higher slip, also with greater immersion.
"3. Thrust increases with number of floats within usual limits.
"4. Effect of increased width of blade is small at small immersions, but at deeper immersions wider blades give greater thrust.
"5. Efficiency decreases slightly with number of floats.
"6. Thrust varies approximately as length of float.
"7. When two wheels are separated, the thrust, except when very close, is that due to two wheels only.
"8. Thrust varies approximately as the diameter for constant immersion.
"9. For a given diameter and immersion the radial delivers more thrust than the feathering, but at a smaller efficiency.
"10. The thrust and efficiency of a feathering wheel vary with the position of the feathering eccentric, the thrust generally decreasing with increase of eccentricity."

Furthermore, the maximum efficiency of the feathering paddle wheel is about 5 percent greater than the maximum efficiency of the radial.

The writer has taken the present feathering wheel, assumed a wake and slip, and from the data given found the thrust and efficiency of this wheel. A radial wheel of the same overall diameter and a length of 7 feet 6 inches, as suggested in the question, to give the same thrust would have an efficiency about 12 percent less than the feathering wheel. In other words, if radial wheels were installed 17 feet overall diameter and about 28 half blades (stepped type) to each wheel, the engine would have to work at roughly 18 percent greater power to produce the go-ahead speed of the present installation. However, if the power remains the same, the speed with radial wheels would be 6 percent less than the ahead speed with feathering (assuming that power varies as V^3). According to your figures, going astern the speed with feathering wheels is 20 percent less than ahead. If we take the speed with radial wheels as 6 percent less than feathering going ahead, installing radial wheels would give a gain of about 4 percent over the average speed made by the feathering wheels.

Although the writer has never heard of its being done, why not arrange the outer bearing of the feathering mechanism so that it may be rotated from a position forward of the shaft center to one aft for going astern. This would make the efficiency going astern equal to that ahead, provided the floats are straight and not curved. However, the complication of such a mechanism might prevent its adoption.

"Some Data on Paddle Wheel Steamers," by C. A. Anderson, MARINE ENGINEERING, 1910, page 445, gives some very interesting data on this subject.

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Shipbuilding and General Marine News

Contracts for New Ships — Shipyard Improvements — Engineering Projects—Improved Appliances—Personal Items

HANDICAPS ON SHIPBUILDING MAY BE OFFSET BY NEW MEASURE

Shipping Bill Provides Means For Overcoming Serious Disadvantages and Placing Our Merchant Marine on a Firm Foundation

So rapidly is the Shipping Board's programme drawing to completion that more tonnage is now under construction in American shipyards for private account than for the Government, says a statement just issued by the Atlantic Coast Shipbuilders' Association. Building for private account took the lead in April, and now holds it by 325,000 gross tons.

Construction records prepared by the association date back to last October, when the shipyards began to be engaged to an appreciable extent on orders for private account. How the totals of Government and private building have compared since that time, and how the excess of Government construction has been steadily pared down are shown in the following table, giving the construction under way in gross tons:

1919	Shipping Board	Private Orders	Governm't Tonnage Lead
October	2,600,146	347,343	2,252,803
November...	2,300,380	550,714	1,749,666
December....	2,095,308	805,147	1,290,161
1920			
January	1,975,000	977,488	997,512
February....	1,829,284	1,256,573	572,711
March	1,629,228	1,337,445	291,783
			Private Tonnage Lead
April	1,311,623	1,404,198	92,575
May	1,140,683	1,466,324	325,641

How the construction since last September has shown a widening gap from the totals for the same months of a year previously is seen in the following comparisons. During the late months of 1918 and the early ones of 1919 practically everything under construction was for the Government, while in the later months private contracts were being carried out on a growing scale in addition to those for the Shipping Board. The figures given are in gross tons:

	1918	1919	Decline from Previous Year
October.....	3,260,000	2,947,489	312,511
November...	3,333,246	2,851,094	482,152
December...	3,419,140	2,900,455	518,685
1919		1920	
January.....	3,537,836	2,952,488	585,348
February....	3,592,438	3,085,857	506,581
March.....	3,733,132	2,966,673	766,459
April.....	3,727,240	2,715,821	1,011,419
May.....	3,584,062	2,607,007	977,955

The manner in which gains in orders for private account for a time counterbalanced the excess of Shipping Board deliveries over new keels laid is indicated by the following table showing gains or losses in comparison with the previous month to the one given, the figures given in gross tons:

1919	Shipping Board	Private Orders	Total Gain or Loss
November..	—299,766	+203,371	—96,395
December...	—205,072	+254,433	+49,361
1920			
January....	—120,308	+172,341	+52,033
February...	—145,716	+279,085	+133,369
March.....	—200,056	+80,872	—119,184
April.....	—317,605	+66,753	—250,852
May.....	—170,940	+62,126	—108,814

\+ Increase. — Decrease.

America now has been definitely passed by Great Britain in the amount of tonnage building, as shown by contrast with the British totals given in the quarterly returns of Lloyd's Register of Shipping, thus:

	British	American	American Lead
Sept. 30, '19.	2,816,000	3,470,000	654,000
			British Lead
Dec. 31, '19.	2,994,000	2,900,000	95,000
Mar. 31, '20.	3,394,000	2,996,000	398,000

American shipbuilders to-day head the world in quality of output and in facilities for production, as well as in speed of construction, but higher labor costs and unfavorable international exchange are handicaps that must be offset by wise application of the new Shipping Bill signed by the President on June 5. It is imperative that a new Shipping Board, as provided by this law, should be immediately appointed and this board should be of such caliber as to assure the respect and confidence of the American public. They will find in the Greene-Jones Shipping Bill all of the authority necessary to protect our shipping and shipbuilding industries and to secure for the American people their position on the high seas, which is so ably defined in the preamble of the Shipping Bill. This preamble states:

"That it is necessary for the national defense and for the proper growth of our foreign and domestic commerce that the United States shall have an American Merchant Marine of the best equipped and most suitable type of ships sufficient to carry the greater portion of its commerce and serve as a naval or military auxiliary in time of war or national emergency, ultimately to be owned and operated privately by American citizens; and it is hereby declared to be the policy of the United States to do whatever may be necessary to develop and encourage the maintenance of such a marine."

Dratfsmen Hold Convention

The ninth annual convention of the American Society of Marine Draftsmen met at the Hotel Harrington, Washington, D. C., June 18 and 19. Representatives from the eleven branches of the society were present. Several amendments to the constitution were adopted, the most important of which relate to the membership. Former associates become associate members, and provision is made for extending the privilege of membership in the society, as associates, to men over twenty-five years of age who hold positions of responsibility in the manufacture or sale of marine equipment or the operation of ships. Co-operation between the manufacturers of equipment and the men who plan its installation in the shipyard and aboard ship is of mutual advantage, and this fact has been recognized by other well-known technical societies. Another amendment provides for the admission of men of eighteen years of age to membership as juniors, who are students in naval architecture or marine engineering at a recognized technical school.

Officers elected for the coming year are as follows: C. E. Deiser, president; E. H. Monroe, vice-president; B. G. Barnes, secretary; J. B. Sadler, treasurer; A. H. Haag, the retiring president, member of executive committee.

Two able and instructive papers were presented, "Notes on Preliminary Design," by J. L. Bates, who is in charge of that work at the Bureau of Construction and Repair, was a very clear explanation of the value of this work and the extent to which it has been developed in the Navy Department; "Joiner Work, Its Relation To and Use in Shipbuilding," by C. J. Early, of the Bethlehem Shipbuilding Corporation, was particularly interesting, as very little literature on this subject is available.

On Friday evening the convention enjoyed a moonlight excursion on the Potomac. On Saturday evening a banquet was given, at which speeches on Americanism, shipbuilding and the future of the society were enthusiastically received.

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E. H. Monroe as toastmaster *was there* with his stories and mimicry. A. H. Haag delivered an able speech on "Americanism," which started a feeling of enthusiasm which grew during the evening, and reached a climax when J. B. Sadler spoke on the future of the society.

ABROGATION OF TREATIES NOT NECESSARY

New Shipping Bill Takes Advantage of Underwood Tariff Act

There is a widespread misconception as to the effect of the Shipping Act of 1920 upon the commercial treaties of the United States with other nations, says a statement issued by the Atlantic Coast Shipbuilders' Association. The general opinion seems to be that the provision for the termination of certain specified stipulations of the treaties is merely a step that paves the way to taking action that will benefit the shipping of the United States. Enforcement of a policy favoring our own vessels over those of foreign countries is regarded as optional, and the enactment of additional legislation to apply the principle of discrimination to the advantage of the American merchant marine is, in the public mind, a necessity.

All these opinions are erroneous. Through the forces created by the enactment of the bill there will automatically be set in motion machinery constructed with a view to the likelihood of the termination of the treaty provision.

A prevalent misconception in connection with the bill is the belief that it requires the abrogation of our commercial treaties. No such step is necessary. Not abrogation of the agreements, but modification of some of the terms is provided for, and automatically brings into play certain provisions of the Underwood Tariff Act of October 3, 1913. These are contained in Section IV of the Act, and are specifically stated in subsections 1, 2-3 and 7. By these sub-sections discriminations in favor of American shipping are provided—except in cases where treaty agreements with foreign nations specifically provide against such discrimination.

Through the operation of Section 34 of the Shipping Act of 1920, the termination of the treaty provisions against discriminations in regard to shipping are provided for, and at the end of the necessary period of notification the indicated provisions of the Underwood Tariff Act are brought into action, as follows:

A 10 percent duty ad valorem is imposed on all imports in vessels not of the United States. All imports by water are forbidden, except in American vessels or vessels belonging to the country from which the imports originate, but this does not apply in cases where nations do not maintain a similar regulation against United States vessels. A 5 percent discount is allowed on all duties on goods imported in American ships.

32 NEW SHIPPING COMPANIES FORMED IN MAY EQUALS RECORD

Capital of $31,983,000 Much Less Than in Preceding Months, But Big Increase Over May, 1919

New shipping enterprises during May included the formation of 32 companies, with an aggregate authorized capital of $31,983,00. In the number of concerns launched the month's activity equaled the top mark so far this year, established in January, but capitalization figures were the smallest for any month to date in 1920. The indicated investment shows a marked drop as compared with April, when the record of $178,835,000, chiefly due to the inclusion in the list of one large company, was set for the Journal of Commerce compilation, which has been maintained since the outbreak of the war in 1914. The May total, however, stands well ahead of that for the corresponding month of last year, $17,200,000. Only concerns with an authorized capital of $50,000 or greater are listed in the compilation.

For the first five months of the current year the records show a total indicated investment of $382,353,000, which is more than $50,000,000 ahead of the aggregate for the entire twelve months of 1919. During January-May a year ago the total rolled up was only $42,801,000. On the basis of these figures the average monthly indicated investment so far this year appears as $76,470,600, compared with $8,560,200 for the corresponding months of 1919, and with $26,967,750 for the entire year 1919.

The average indicated investment per company for May figures out as $999,469. This is the lowest average for any month so far this year, comparing with $8,128,864 in April, $2,945,237 in March, $1,963,530 in February and $2,384,531 in January. The average per company for the first five months of the year appears as $3,083,490, a figure which demonstrates the importance of the new units in shipping enterprise that have sprung up this year. Actually 57 companies of the 124 organized have an authorized capital of $1,000,000 or greater, which is regarded as a reasonably large proportion.

The indicated investment in new shipping enterprise during the periods indicated is shown in the following table:

August-December, 1914	$1,844,000
Year 1915	37,062,000
Year 1916	$69,466,000
Year 1917	271,508,000
Year 1918	120,353,000
Year 1919—	
January	7,525,000
February	6,400,000
March	9,276,000
April	2,400,000
May	17,200,000
June	55,550,000
July	42,485,000
August	55,950,000
September	40,870,000
October	23,405,000
November	52,700,000
December	10,362,500
Total	$323,613,000
Year 1920—	
January	$76,305,000
February	33,380,000
March	61,850,000
April	178,835,000
May	81,983,000
Total, five months, 1920	$382,353,000

More companies with an authorized capital of $1,000,000 or greater were organized in May than in any previous month of the year, notwithstanding that the May total is the smallest to date in 1920. The number of concerns of such proportions incorporated in the month was 15, compared with 13 in April, 12 in March, 7 in February and 10 in January.

The following list gives the names, state of incorporation and authorized capital of shipping companies organized in May:

Arapahoe Navigation Co., Dela.	$275,000
Bee Line Transportation Co., Dela.	2,000,000
Baltic Steamship Corp., N. Y.	500,000
Cummins-McDonald Navigation Co., Dela.	50,000
Casco Bay Lines, Me.	75,000
F. A. S. Line, Inc., The, Dela.	250,000
First National Steamship Co., Dela.	600,000
International Transportation Co., Dela.	1,000,000
Luckenbach Terminals, Inc., N. J.	2,000,000
Muscoota Navigation Co., Dela.	400,000
Mercantile Lines, Inc., Dela.	500,000
Mount Shasta Steamship Co.	1,556,600
Neptune Shipping Corp., N. Y.	200,000
Nyanza Steamship Co., Ltd., Dela.	1,000,000
Pacific Motorship Co., Dela.	3,250,000
Paragon Navigation Corp., Dela.	100,000
Pitt Navigation Co., Dela.	51,000
Rhode Island Steamboat & Lightering Co., R. I.	100,000
Steamship & Shipyard Equipment Corp., Dela.	100,000
Spindrift Shipping Corp., N. Y.	80,000
Tonawanda Navigation Co., Dela.	275,000
Talbot Steamship Co., Dela.	2,200,000
Unsinkable Boat Co., The, Dela.	2,000,000
U. S. Mail Steamship Co., N. Y.	200,000
U. S. Ocean Services, Inc., N. Y.	1,000,000
Willsolo Steamship Co., Dela.	2,200,000
Western Steamship Co., Dela.	500,000
Westbrook Steamship Co., Dela.	1,857,600
Willhilo Steamship Co., Dela.	2,910,000
Willfero Steamship Co., Dela.	1,000,000
Westlake Steamship Co., Dela.	1,837,800
Yellowstone Steamship Co., Dela.	2,225,000
Total	$31,983,000

Oiler Adapted to Marine Uses

A new type of oiler has been developed by the National Marine Lamp Company, Forestville, Conn. This oiler is well adapted to marine uses. Special features include an interchangeable spout, a spring check valve, a filler hole having an eccentric revolving cap. The fact that the spout is detachable and so may be renewed insures long service from the oiler. Complete data on various types of orders will be supplied on request.

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RULES FOR MOTORSHIPS

American Bureau of Shipping to Frame New Regulations

Largely through the efforts of Captain C. A. McAllister, vice-president of the American Bureau of Shipping, representatives of American companies engaged either in the production of internal combustion engines or motorships met in conference on June 7 at the offices of the American Bureau of Shipping, 66 Beaver street, New York, for the purpose of formulating and adopting new rules for the survey and classification of motorships.

The following were present: Dr. Charles E. Lucke and W. B. Jennings, Worthington Pump & Machinery Company; Robert Warriner, Bethlehem Shipbuilding Corporation; D. W. Armstead, Bethlehem Steel Company; J. A. Seymour and Harte Cooke, McIntosh-Seymour Corporation; Max Rotter and George D. Pogue, Busch-Sulzer Company; James Craig, Craig Engine & Machine Works; Charles F. Bailey and John F. Nichols, Newport News Shipbuilding Company; Mr. Schilling, Scandia-Pacific Oil Engine Company; C. B. Edwards, New York Shipbuilding Company; L. N. Wheelock, Boston (141 Milk street); Mr. Anderson, New London Ship & Engine Building Company; E. A. Thomee, Bolinders Company; H. C. Verhey, consulting engineer; T. O. Lisle, editor, *Motorship;* F. B. Webster, editor, MARINE ENGINEERING; Chas. A. McAllister, vice-president, E. G. Tuck, chief surveyor, and Joseph Hecking, engineering staff, American Bureau of Shipping.

A telegram was received from Wm. Cramp & Sons expressing regret at the unavoidable absence of their representative, and letters, displaying keen interest and promising co-operation, were received from the following: Opposed Piston Oil Engine Company, August Mietz Corporation, Nordberg Manufacturing Company, Dow Pump & Diesel Engine Company, J. C. Rolph, Standard Oil Company.

Captain McAllister opened the meeting at 10:15 A. M., and after explaining in short the object of the conference, relinquished the chair to Mr. Hecking, of the Bureau's engineering staff.

Insurance rates for motorships quoted by Mr. Stevens, of the Marine Office of America, showed that the rates for wooden vessels without engines were less than for those fitted with engines, and that the rates for steel vessels fitted with Diesel engines were higher than for those fitted with reciprocating engines. While it was the opinion of those present that the fire hazard on Diesel propelled ships is over-rated, and that the insurance rates are discriminating against Diesel installations, it appeared to be the opinion of the builders that the requirements for Diesel installations should be expanded, without placing any undue restrictions on the designer, for the protection of the experienced and reliable builders, as a check upon any new and untested designs and for the safety of the engines and vessels.

Such questions as testing materials and cylinders, proper size of crankshaft, requirements for pumps and auxiliaries, lubrication, circulation of water, etc., were discussed at length, and it was decided to appoint a sub-committee to cooperate with the Bureau's engineering staff in formulating rules to be submitted to the manufacturers for approval and adoption. This advisory committee is composed of the following:

Dr. Charles E. Lucke, chairman, Worthington Pump & Machinery Company, 115 Broadway; Arthur West, Bethlehem Steel Corporation, Bethlehem, Pa.; Bruno Nordberg, Nordberg Manufacturing Company, Milwaukee, Wis.; Harte Cooke, McIntosh-Seymour Corporation, Auburn, N. Y.; John F. Nichols, Newport News Shipbuilding Company, Newport News, Va.

As Admiral W. S. Benson has given his endorsement to the motorship, and as Congress has appropriated $25,000,000 annually to loan to steamship companies for the construction of vessels powered with the most economical, efficient and modern type of machinery, it is predicted that an era of motorship construction is about to commence. In any case it is fortunate that the Bureau has secured the co-operation of the manufacturers in formulating its classification requirements for motorships.

Allan E. Goodhue Promoted

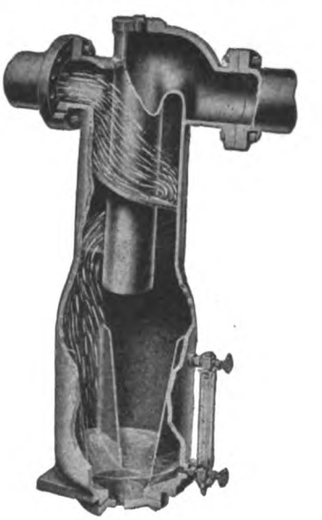
The Chicago Pneumatic Tool Company, New York, announces the election of Allan E. Goodhue as vice-president in charge of sales. Mr. Goodhue, since May 1, 1919, has been managing director of the company's English subsidiary, the Consolidated Pneumatic Tool Company, London, England, also director of European sales for the Chicago Pneumatic Tool Company.

Allan E. Goodhue

Mr. Goodhue was formerly for a number of years connected with the sales department of the Midvale Steel Company and Midvale Steel & Ordnance Company, in Philadelphia, Chicago and Boston, leaving that company in March, 1918, to enter the service of the Government. From that time until January 1, 1919, when he became connected with the Chicago Pneumatic Tool Company, he was assistant manager of the steel and raw material section, Production Division, of the Emergency Fleet Corporation. Mr. Goodhue returns from Europe in time to permit assuming his new duties early in July.

Steam Separators

The Stratton steam separator, produced by the Griscom-Russell Company, 90 West Street, New York, has been developed for the purpose of freeing the pipes and fittings of steam power installations of all moisture. It is designed to prevent all scale, grit, broken tools, as well as moisture, from entering either the engine or the turbine. A collecting chamber of the separator performs the function of a cushion for the pulsations of the steam, and serves to take care of sudden variations in load.



The Stratton Steam Separator

The separator employs the centrifugal principle for separating entrained water from the steam. As the steam and water enter the device they pass through a helical path formed about a central cylinder. The high velocity of the incoming steam and water causes the entire mass to whirl as it passes from the helical channel into the main body of the separator. Water, being many times heavier than the steam, does not follow the turn so easily, but is thrown out of the whirling current of steam by centrifugal force. The path is so proportioned that the particles of water as they leave the steam current meet the walls of the device without splashing and flow into the receiver, at which point the whirling motion of the water is checked by baffles, thus permitting drainage to be easily accomplished.

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SHIPPING BOARD HAD 9,243,464 TONS CONTROLLED ON JUNE 5

Fleet Lacks Combined Passenger and Cargo Vessels; Deliveries in May Below Those of April; No Keels Laid in Month

Vessels owned and controlled by the Shipping Board as of June 5 numbered 1,493, aggregating 9,243,464 tons deadweight, including 956 contract steel vessels of 6,429,059 tons, 205 requisitioned steel vessels of 1,334,669 tons, 271 wood and composite vessels of 997,854 tons, four concrete vessels of 13,500 tons, 24 purchased vessels of 157,921 tons, 31 seized German and Austrian vessels of 291,821 tons and two vessels of 18,700 tons chartered from Peru. Cargo tonnage predominates, 1,388 vessels of 8,273,246 tons falling under this heading, while the fleet includes also 59 tankers of 549,280 tons, 15 refrigerator ships of 112,620 tons and three transports of 26,621 tons.

Deliveries of new ships to the Shipping Board by American shipyards during May fell far below the high mark established in April. They numbered only forty-six vessels, aggregating 256,410 tons deadweight, representing a reduction of approximately 50 per cent as compared with April, when eighty-nine ships aggregating 522,683 tons deadweight were turned over to the Government.

The slowing up in activity revealed by the official figures is believed to be due in a measure to labor troubles at the shipbuilding plants and also to the fact that as the program of the Emergency Fleet Corporation draws nearer to a close the shipbuilding facilities are less concentrated on work for the Government.

No keels were laid during May, but twelve vessels were launched, all of them steel, aggregating 97,600 tons. The number of keels remaining to be laid is twenty-two, all contract steel ships. May deliveries included thirty-three contract steel vessels of 228,110 tons deadweight, two requisitioned steel vessels of 13,000 tons, five wooden ships, tonnage not stated, and two concrete vessels totaling 15,000 tons. An official statement compiled as of June 5 shows that one contract steel vessel of 5,075 tons and two wooden ships were delivered this month up to that date. One launching took place during this period, a 10,000-ton steel vessel slipping down the ways.

The lack of combined cargo and passenger vessels to balance the fleet is demonstrated by the fact that only twenty-eight of this type, aggregating 281,697 tons, are included in the compilation, all obtained by seizure from Austria and Germany except two chartered from Peru.

Following is a comprehensive view of the Government program:

	Keels Laid		Launched		Delivered	
	No.	D. W. T.	No.	D. W. T.	No.	D. W. T.
Month to Date—						
Contract steel	1	10,200	1	10,000	1	5,075
Year to Date—						
Contract steel	25	228,150	158	1,204,718	220	1,486,139
Requisitioned steel	6	61,400	7	61,770	10	82,870
Wood	..	.....	16	31,050	43	84,650
Concrete	..	.....	....	.....	3	18,500
Total	31	289,550	181	1,297,538	276	1,672,159
Total to Date—						
*1,300 Contract steel	1,278	8,597,245	1,172	7,649,245	1,073	6,842,187
* 384 Requisitioned steel	384	2,687,266	374	2,585,966	372	2,572,666
* 18 Composite	18	63,000	18	63,000	18	63,000
* 589 Wood	589	1,885,250	589	1,885,250	570	1,881,250
* 12 Concrete	12	73,500	7	36,000	6	28,500
Grand total, *2,303	2,281	13,306,261	2,160	12,219,461	2,039	11,387,603

* Number of ships on active programme.

ALIENS MAY LEASE SHIPS

Temporary Measure Provides For Three Months Time Limit

The United States Shipping Board has passed a resolution providing that vessels documented under the laws of the United States may be chartered for periods not exceeding three months, or for a voyage the probable duration of which will not exceed three months, to persons not citizens of the United States.

This order is issued to temporarily care for the situation brought about by the passage of section 18 of the Merchant Marine Act of 1920, which amends section 9 of the Shipping Act of 1916, in such manner as to require the forfeiture of the vessel in the event of a charter to aliens other than under regulations prescribed by the board. At a later period specific regulations will be issued by the board covering the subject of voyage and time charters.

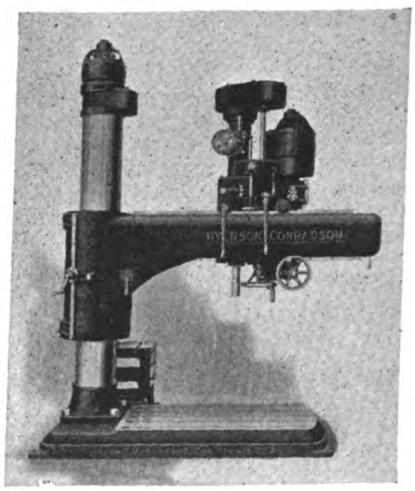
Bids Wanted for Ocean Mail Service

The Post Office Department will receive bids until September 15, 1920, for ocean mail service in vessels of the first-class, service to begin October 12, 1920. This work is under the provisions of the mail subsidy act of 1891. Circulars containing descriptions of the routes, instructions to bidders, and blank forms of proposals with bonds may be obtained from the Second Assistant Postmaster General after July 1.

High Power Radial Drilling Machine

Among the new machine tools being placed on the market by Joseph T. Ryerson & Son, Chicago, Ill., is the Ryerson-Conradson Twin Motor-Driven High Power Plain Radial Drilling Machine.

This machine differs somewhat from the usual design, and drilling, tapping, boring and reaming operations can be performed equally well. The machine has but four shafts and sixteen gears. The



High Power Radial Drilling Machine

spindle and driving shafts are contained in a single cast box of rigid construction. Only spur gears are employed, eliminating bevel gears and the consequent trouble of alinement.

The special features of the machine include a twin-motor drive, one motor being used for driving the spindle and the other for elevating purposes, mounted on the column. All bevel gears and friction clutches for tapping have been eliminated. Because of the box section design of the arm, the usual overhanging head is done away with. In the spindle drive arrangement there are only three gear transformations, which eliminates the numerous bevel gears usually found necessary. In getting rid of these gears, the trouble of alinement has also been avoided. Because of the construction, the tool may be operated on a true radial line with the column. The long bearing surface and double-acting clamping device of the arm on the column reduces all springing and sagging action to a minimum.

Support for Waterways Bill

At the third annual convention of the Mississippi Valley Waterways Association, in St. Louis, April 19, resolutions were adopted strongly urging the passage of the Newton Bill, providing means for completing the plans adopted for the improvement of the Mississippi, Ohio, Illinois and Missouri Rivers, urging the appointment of a man familiar with the subject as a member of the Interstate Commerce Commission, and the building of twenty-four barges suitable for grain, flour and merchandise.

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STATE BARGE CANAL TO HAVE GREATLY INCREASED SERVICE

New Companies to Handle Bulk Cargo in Both Directions Direct Between New York and Western Ports

The following circular for the information of shippers of freight through the New York State Barge Canal, giving details as to the plans of new companies engaged in handling that traffic, has been issued by Edward S. Walsh, State Superintendent of Public Works:

"The Inland Marine Corporations, S. W. Bullock, traffic manager, 132 Nassau Street, New York City. This company will operate a line of steamers and barges between Buffalo and New York City accepting east and west-bound bulk cargo for practically all ports between Albany and Buffalo, inclusive. Carload and less carload freight will be accepted from New York for Buffalo and points west via canal and lake.

The Lake Champlain Transportation Company, C. E. Holden, general manager, Whitehall, N. Y. This company will operate a number of barges in a bulk cargo service on the Champlain and Erie divisions of the canal system, accepting freight for all ports between Buffalo and Albany, and to and from points in Canada, reached through Lake Champlain and connecting waters to the St. Lawrence River.

"The New York and Western Canal Line, H. J. Ware, general manager, New York City. This company will operate a number of barges in a general cargo service from New York City to all canal ports west of Albany. Bulk cargo will be handled from all ports west of Albany in eastbound movement.

"E. G. Murray Lighterage & Transportation Company, E. G. Murray, general manager, New York City. This company will furnish barges for bulk cargo, loading from New York to any canal port.

"Marine Express Company, R. H. Barnwell, general manager, New York City. This company will operate a number of barges providing a weekly service between New York City and ports on the Oswego division of the canal system, including the port of Oswego.

"In addition to the foregoing, there are available for service a number of individually owned and operated barges. Arrangements may be made for the charter of such boats direct with the owners or operators, or inquiry may be directed to Traffic Bureau, Department of Public Works, Albany, N. Y., and shippers will be placed in touch with boat owners. On eastbound traffic the Seaboard Forwarding Company, 72 Pearl Street, Buffalo, N. Y., and the Marine Forwarding Company, Chamber of Commerce Building, Buffalo, N. Y., will furnish equipment and quote rates.

"The Department of Public Works will operate a fleet of towing tugs on the Erie, Oswego and Cayuga-Seneca divisions of the canal system. Boats will be towed by department tugs at the following rates:

LOADED	Cents Per Mile
300 ton or less	35
300-350 ton	42
350-400 ton	49
400-450 ton	56
450-500 ton	63
500-550 ton	70
550-600 ton	77

LIGHT	Cents Per Mile
Up to 100 feet long	20
100-110 feet long	25
110-120 feet long	30
120-130 feet long	35
130-140 feet long	40
140-150 feet long	45

"Barges or other craft of greater burden or dimensions will be towed at a rate to be fixed on application to the department."

Yachtsmen Have Organization

An organization to be known as "The Yacht Brokers' Association" has been formed for the following purposes: To generally encourage a greater interest in the sport of yachting; to render more efficient service to yachtsmen and cooperate more closely with those interested in the sport; to protect and further the interests of those legitimately engaged in the yacht brokerage business; to adopt a common system for registering competent and reliable officers and crews for the benefit of yacht owners in general.

The constant activity of yacht brokerage firms unquestionably develops material advantages to the yachting fraternity, in that it tends to create a market for owners who desire to dispose of or charter their vessels and to establish reasonable and to some extent a standard value for their property.

Marine Control Apparatus

The Cutler-Hammer Manufacturing Company, of Milwaukee and New York, describes and illustrates their electrical control equipment for use on board ship in a two-color booklet with the above title.

The extensive use of electric control in the marine field is emphasized by the statement that on a battleship, for instance, "there are approximately 225 motor and controller equipments used with the auxiliaries, of which there are 45 different control applications, and the sizes range from 1 horsepower to 175 horsepower." The booklet illustrates and describes the controller panels and double master controller with two drum levers for controlling a boat crane. One drum lever controls the hoist motion and the other the rotating motion. A solenoid-operated valve for use with submarine torpedo tubes is an interesting piece of apparatus. The officer at the periscope, when he has sighted his prey, closes a switch which operates the valve, admitting compressed air to the torpedo tube and sending the torpedo on its errand. Many other controls for capital and merchant ships and submarines are illustrated. According to the booklet, Cutler-Hammer control apparatus has been supplied to the United States Navy for the past twenty years.

OBITUARY

WHITFIELD P. PRESSINGER

Whitfield P. Pressinger, of New York, vice-president, Chicago Pneumatic Tool Company, died June 10 as a result of complications following an operation. Mr. Pressinger was actively engaged in the pneumatic tool and allied machinery industry for many years. He was general manager of the Clayton Air Compressor Company for seven years, and became widely known through numerous activities in the American Society of Mechanical Engineers and the Compressed Air Society. He was born in New York City in 1871.

Whitfield P. Pressinger

In addition to the foregoing societies he was a member of the Sons of the Revolution, 7th N. Y. Regiment Veterans, F. and A. M., and the Engineers, Lawyers, New York Athletic, New York Railroad, Columbia Yacht and the Machinery Clubs of New York.

Baizley to Build Big Dock

The proposed $6,000,000 drydock plant at Gloucester City, N. J., is to be built by the John Baizley Iron Works, according to an ordinance passed by the City Council, which provides for the closing of three streets on the water front, that the work must be started promptly, and the plant put in operation as soon as it is finished.

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NEW U. S. MAIL LINE LEASES THIRTEEN EX-GERMAN STEAMERS

Subsidiary of the France and Canada Steamship Corporation Gets Some Fine Ships for European Passenger and Freight Traffic

Thirteen former German passenger steamers, including the George Washington, President Grant and America, have been chartered from the Shipping Board by the United States Mail Steamship Company, a subsidiary of the France and Canada Steamship Corporation, 120 Broadway, New York. The total tonnage involved is about 90,000 tons, and the Shipping Board states that the stock ownership and management of both concerns is 100 percent American, the France and Canada Corporation being the unconditional guarantor of the United States Mail Steamship Company under the terms of the charter, which is for five years, and will mean an income to the Shipping Board of about $20,000,000.

The vessels chartered are the George Washington, Pocahontas, Mount Vernon, Callao, Susquehanna, President Grant, America, Princess Matioka, Agamemnon, Antigone, Amphion, Freedom and Madawaska.

These vessels are to ply routes from New York and Boston to British, French and German ports and to Danzig. The chartering company is also to have the right to run service to Mediterranean ports. At the expiration of the five-year period of charter the company is to have the first chance to purchase the vessels at prices and under terms to be then fixed by the Shipping Board.

Two more vessels, the Aeolus and the Huron, are to be chartered under the same conditions if the Shipping Board can obtain their release from present obligations.

The essential terms of the contract between the Shipping Board and the United States Mail Steamship Company are given by the Shipping Board as follows:

"The United States Mail Steamship Company is to recondition these vessels for passenger service at its own expense. The plans for reconditioning are to be subject to the approval of the Shipping Board. The steamship company is to pay the government a bare boat charter hire at the rate of $3.50 per net registered ton per month. Off hire, for overhauling and repairing is permitted, but not to exceed thirty days in any one year.

"The charter is to run for a period of five years. At the termination thereof the steamship company has the first chance to purchase the vessels at prices and terms then to be fixed by the board. In case of purchase the steamship company is to be credited on the purchase price with the amount of money spent in reconditioning vessels for service, minus depreciation, at the rate of 7½ percent per annum. If the steamship company does not purchase, the amount so spent in reconditioning, minus depreciation, is to be returned in cash.

"Under the charter, all of the expenses of operation of these vessels, including insurance, are to be borne by the steamship company, and the return to the government is net.

"The contract also provides that, in the event that the steamship company enters into any contract with the North German Lloyd Steamship Company or the Hamburg-American Lines for the use of the piers,, warehouses, facilities, etc., of either of said companies, such agreement shall be subject to the approval of the Shipping Board.

"The steamship company also agrees to take the Aeolus and the Huron under the same conditions, provided the Shipping Board can secure their release from their present commitments to the South American service by the substitution of other suitable vessels.

"The routes for which the vessels are chartered are as follows:

"New York - Queenstown - Cherbourg-Bremen. Returning via Cherbourg - Southampton. Alternative route. New York-Dover-Boulogne-Danzig.

"Boston - Queenstown-Cherbourg-Bremen. Returning via Southampton-Cherbourg."

The George Washington, formerly of the North German Lloyd, carried President Wilson four times across the Atlantic in connection with the Paris Peace Conference: and the Mount Vernon was attacked and badly damaged by a German submarine.

British Shipyards Combine

A combination of small but efficient British shipyards is announced. The Rennie Forrest Shipbuilding, Engineering & Dry Dock Company, of Wivenhoe, Essex, has joined with William Chalmers & Company, of Rutherglen, and Ritchie, Graham & Milne, of Glasgow, to form the Rennie, Ritchie & Newport Shipbuilding Company, Ltd., with a capital of £500,000. The net assets taken over are valued at £330,000. Works are to be established at Newport, Monmouthshire. The new company will have one yard on the east coast of England, one on the west coast, and two on the Clyde.

MORRIS M. WHITAKER

Joins Tams, LeMoine & Crane Naval Architects

Morris M. Whitaker, naval architect, has joined forces with Tams, LeMoine & Crane, of 52 Pine Street, New York, and will have active charge of the designing and supervision of the construction in the commercial and cargo ship department, as well as their yacht work.

Mr. Whitaker comes from a family which has followed the sea for generations, his father having been a chief engineer in the United States Navy, serving through the Civil War and up to 1895. He was graduated from Yale, and started his professional career with the Newport News Shipbuilding and Dry Dock Company. From there he went to Cornell University to take a post-graduate course

Morris M. Whitaker

in naval architecture, following which he returned to the Newport News yard, and later took charge of the construction of C. R. Flint's famous steam yacht *Arrow*.

During the war he was engaged on special engineering work for the Russian Navy, and later designed and laid out a yard for building submarine chasers. During the latter part of 1917 he was engaged by the Emergency Fleet Corporation to design and standardize life-saving equipment.

Tams, LeMoine & Crane have been in business since 1895, and prior to that the same business was carried on under the name of Tams & LeMoine, which partnership commenced in 1888. They have built several well-known yachts, and at present are doing considerable work for South American and Australasian clients, including a tug for British Guiana, a small, shallow-draft Diesel-driven cargo vessel and several barges for South American use.

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PERSONAL AND BUSINESS NOTES

G. L. Buchanan has been appointed Cuban representative of the American Bureau of Shipping, with headquarters in Havana, Cuba.

The Pennsylvania Pump & Compressor Company, of Easton, Pa., announces the opening of sales offices in the following cities: New York, 50 Church Street, H. C. Browne, manager; Philadelphia, Pa., 2222 Chestnut Street, W. J. Devlin, manager; Pittsburgh, Pa., 631 Fulton Building, C. W. Gellinger, manager; Richmond, Va., Mutual Building, W. F. Delaney, manager; Birmingham, Ala., 2027 Jefferson Bank Building, H. I. Kahn, manager; Salt Lake City, Utah, Newhouse Building, C. H. Jones, manager; Milwaukee, Wis., 604 First National Bank Building, Coates & Zarling, representatives.

The Page Steel & Wire Company announce the change of their central district sales office from 29 South LaSalle Street to 208 South LaSalle Street, Chicago, Ill. All communications should be sent to our new address.

The Milwaukee Electric Crane & Manufacturing Company, Milwaukee, Wis., announces the appointment of Mr. R. K. Morse as western manager, with offices in the Pittock Block, Portland, Oregon.

The business of the estate of John Nazel has been succeeded by the Nazel Engineering & Machine Works, a corporation chartered in Pennsylvania, with the following officers: Ralph W. Nazel, president and general manager; C. H. Wackernagel, vice-president and assistant manager; J. Milton Nazel, secretary and treasurer.

The trustees of the pension fund of Fairbanks, Morse & Company, 900 South Wabash Avenue, Chicago, Ill., report for 1919 eight members pensioned, death benefits of $11,675, and net resources of $505,000, practically all invested in high-grade bonds. The fund was established on January 1, 1917, and at the close of 1919 had 1,139 contributing members.

Engineering clubs and societies, manufacturers' associations, commercial organizations, technical schools and the educational departments of large corporations will be interested in the announcement that the Diamond Power Specialty Company, Detroit, Mich., now has available for free distribution three copies of its motion picture, "Coal Is King." This picture was prepared from a scenario by Robert June, and the pictures were taken under his direction by the Ford Motor Company.

Craig Adair, formerly vice-president of Penn Seaboard Steel Corporation, and Mr. Paul Day, of the same corporation, have resigned and have formed the Adair-Day Corporation. They will make a specialty of anchors and chain, gray iron, steel and brass castings, for marine work, general steel products and mechanical specialties, with offices at 1025 Widener Building, Philadelphia, Pa.

Walter Kidde & Company, Inc., of 90 West Street, New York City, announce the appointment of J. G. White & Co., Ltd., of London, and L. A. Blake, Inc., of Buenos Aires, as representatives in England and Argentina, respectively, for the sale and installation of the Rich System for Detecting and Extinguishing Marine Fires. The two companies will also establish service stations similar to those now maintained by Walter Kidde & Company in the United States.

The Greenfield Tap and Die Corporation, Greenfield, Mass., has acquired 100 percent of the common stock of the Lincoln Twist Drill Company, of Taunton, Mass, manufacturing twist drills, reamers and milling cutters. These, added to the products of the Greenfield Tap and Die Corporation, gives them a complete line of small tools. The Taunton plant will be enlarged as necessity requires to meet the demands for its products. Mr. Edward Blake, Jr., formerly sales manager of Wells Brothers Company, is vice-president and general manager of the Lincoln Twist Drill Company.

William H. Easton, of the Department of Publicity of the Westinghouse Electric & Manufacturing Company, 165 Broadway, New York, has been placed in charge of the publicity work of that company's marine department.

Mr. Carl Wigtel, vice-president and chief engineer of the Watson-Stillman Company, sailed on June 14 for a ten weeks' trip to Scandinavian countries. He also expects to visit England, France, Belgium and Holland. While he is going mainly for a vacation, this being his first trip to his old home in Norway since his connection with the Watson-Stillman Company thirty-three years ago, he will also investigate new developments in the line of hydraulic machinery in all of the countries named.

At the meeting of the Engineering Advertisers' Association at the Hotel LaSalle, Chicago, on June 8, Mr. Louis Flader, of the American Photo Engraving Association, gave an interesting talk on photo engraving. Mr. Flader's business career has been devoted almost exclusively to the engraving field and he knows his subject thoroughly. The Engineering Advertisers' Association will rest during July and August; the next regular meeting will be held on September 14.

The Penn Seaboard Steel Corporation's new blooming mill at New Castle, Delaware, is now in operation. This mill is a two-high, 34-inch, reversing mill, directy connected to a 6,000-horsepower Westinghouse motor, and equipped with motor-driven screw-down and manipulator.

TRADE PUBLICATIONS

Hack Saws and Their Use is the title of a booklet issued by the L. S. Starrett Company, Athol, Mass., describing the saws, their use, and also contains many suggestions and tables.

Marine Equipment.—Catalogue No. 19, issued by the Stevens, Aylesworth Company, Inc., illustrates with detail drawings some of the many types of marine accessories that this company has produced.

Whiting Cranes.—The Whiting Foundry & Equipment Company, Harvey, Ill., in its 1920 bulletin No. 151, extensively describe and illustrates cranes and various other foundry and railway equipment manufactured by the concern.

Propeller Wheels and Marine Steam Engines.—The H. G. Trout Company, Buffalo, N. Y., in a catalogue just issued describes and profusely illustrates the propellers and engines built by them and the various shops in which they are manufactured.

Standard Anti-Noise Marine Telephones.—This bulletin, published by the Magnavox Company, 2701 East 14th Street, Oakland, Calif., describes and extensively illustrates the Magnavox anti-noise marine telephone, ttype MD-2, its installation and operation.

Steam-Reducing Valve.—The Chaplin-Fulton Manufacturing Company, 28-34 Penn Avenue, Pittsburgh, Pa., in a four-page pamphlet recently issued, describes and illustrates the Fulton steam-reducing valve, as well as price lists of the various types.

Standard Underground Tubes, Rods and Wires.—The Standard Underground Cable Company's bulletin No. 100-1 contains many useful dimensions and tables as applied to the tubes, various kinds of metal tubes, rods and wire manufactured by the company. A complete price list is also given.

Chadburn's Ship Telegraph.— In this catalogue issued by the Chadburn Ship Telegraph Company of America, Troy, N. Y., are described and illustrated the many types of ship telegraphs, engine counters, horoturbometers, etc., manufactured for the merchant service, and the United States Navy.

Portable Alternating Current Apparatus for Cutting and Welding Metals is the title of a catalogue just issued by the Electric Arc Cutting & Welding Company, 222 Halsey Street, Newark, N. J., which describes in detail the company's new welding apparatus, and illustrates its application in actual practice.

The Aerial Railway of Industry is the title of an interesting catalogue recently published by the Shepard Electric Crane & Hoist Company, Montour Falls, N. Y. It describes in detail the Shepard electric cage-operated monorail hoist, which not only loads and unloads, but also conveys the material to any part of the plant or yard.

A Catalogue of Windlasses has just been published by the American Engineering Company, Philadelphia, Pa., which gives full descriptions and illustrations of the various kinds of windlasses manufactured by the company. They call special attention to the fact that they manufacture windlasses to meet the special preferences of shipowners and engineers.

Fire Detecting and Extinguishing System.—Walter Kidde & Company, Inc., 90 West Street, New York, have just issued a revised pamphlet explaining and illustrating with photographs the operation of the improved Standard "C" type of the Rich system for detecting and extinguishing marine fires. Another pamphlet issued by this company contains an address delivered to a recent meeting of insurance men, in which the system is reviewed in more technical detail.

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Marine Construction News of the Month

Ship Contracts—New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPS AND SHIPYARDS

Traveling Crane, Newport News, Va.—The Newport News Shipbuilding Company is in the market for a 100-ton traveling crane.

Schooner Contracts, Hoquiam, Wash.—The Peninsular Shipbuilding Company has contracts in sight for building a number of steam schooners for the lumber trade.

Tankers, Quincy, Mass.—Work will soon start at the Fore River plant of the Bethlehem Shipbuilding Corporation on two vessels for the Sinclair Oil Company, New York.

New Shipyard, Ghent, Belgium.—The Lloyd Royal Belge plans to establish a new shipyard at Ghent under the designation of The Lloyd Royal Belge (Great Britain), Ltd.

To Build Railway Equipment, Jacksonville, Fla.—The Merrill-Stevens Shipbuilding Corporation is said to plan going into the construction of locomotives, cars and other railway equipment.

Shipyard Sold, Stratford, Conn.—The Housatonia Shipyard has been purchased from the Shipping Board by Albert T. Stuart, president of the A. T. Stuart Company, Newton, Mass.

Steel Steamers, Vancouver, B. C.—According to word from the Department of Marine and Fishers, Ottawa, two more steel 8,100-ton steel steamers are to be built at the Coughlan Yards.

Barges, Jacksonville, Fla.—The Gibbs Gas Engine Company is building six barges for M. Garcia, two of which have just been completed. They will be towed to Cuba and used in the sugar industry.

New Shipyard, Metropolis, Ill.—Contracts are to be awarded by a shipbuilding concern at Memphis, Tenn., for a marine ways at Metropolis, Ill. The yard will extend for several blocks along the river front.

Lighters, Jacksonville, Fla.—The Jacksonville Shipping Corporation is having six lighters built for use in Cuban harbors in unloading freight. They will be 30 by 80 feet, and will carry 100,000 feet of lumber.

Shipyard to Resume, Manitowoc, Wis.—C. C. West has bought the Manitowoc Shipbuilding Company's plant for $410,000. He intends to reorganize the concern and continue operations. The plant originally cost $1,500,000.

Barge, Orange, Tex.—The National Shipbuilding Company will soon start work on a 125-ton barge on the deck of a 300-foot by 40-foot barge, being constructed for the National Oil Transport Company for use in the oil trade.

Steamers to Be Made Barges, Mobile.—Two unfinished steamers on the ways of the Murnan Shipbuilding Company are to be turned into barges. They are 5,000-ton vessels, and were originally intended for cargo ships.

Salvaging, London, England.—Offers by salvage companies for the recovery of about 120 unsalvaged wrecks around the coast of the United Kingdom in approximately 12 fathoms of water will receive consideration by the British Admiralty.

Shipyard to Resume, Machias, Maine.—The Job Shipyard is to resume work soon on a four-masted schooner, new arrangements having been completed; frames for two smaller vessels are in the yard, and work on them is to begin promptly.

Increase of Capital, Gulfport, Miss.—The International Shipbuilding Company, with a New York office at 71 Broadway, which is building steel steamers, has been compelled by increased business to increase its capital of $1,000,000 to $5,000,000.

Steel Freighter, Port Jefferson, N. Y.—The New York Harbor Dry Dock Corporation, which recently purchased the Bayles Shipyard, has begun construction of a 5,000-ton steel freighter, a sister ship of the Conimicut, which was launched June 5.

Converting Steamer, Seattle, Wash.—The new Japanese-built steamer Eastern Importer has been delivered to the Shipping Board at Seattle. She will be converted into an oil burner at one of the yards at an expenditure of about $80,000.

Shipyard Plant Buildings, Wareham, Mass.—The Cape Cod Shipbuilding Company will begin active operations on several new buildings at its yard. They will include machine, construction, blacksmith and other shops, with storehouse and office buildings.

Ship Steel Plant, Luzon, Quebec.—The Davie Shipbuilding Corporation, Levis, Quebec, a subsidiary of the British Empire Steel Corporation, has taken options on property in Luzon with the intention of building a plant for the manufacture of ship steel.

Motorship, Norway.—The keel for a motorship of 9,000 tons will be laid on the ways of Rosenborg's Werft at Stavanger. The vessel will have two Diesel engines of 1,700 horsepower. It is expected that the ship will be ready for delivery in the summer of 1921.

Six-Masted Schooner, Astoria, Ore.—The Wilson Shipbuilding Company submitted a proposal to the Port of Astoria Commission to alter the Ferris hull, now in the company's yards, into a six-masted schooner and turn her over to the port at a cost of approximately $197,000.

Tankers, Vancouver, Wash.—The G. M. Standifer Construction Corporation have contracts for building three 12,000-ton tankers, the keel for the first having just been laid. The company still has two of the 9,600-ton freighters for the Green Star Line, of New York, to be built.

To Build Big Steamers, Los Angeles, Calif.—The Los Angeles Shipbuilding Company has a contract for five 12,500-ton steamers, on which work has not been started. The Southwestern Shipbuilding Company has seven steamers to complete, including two tankers of 12,500 tons each.

To Build River Steamboats, Vicksburg.—The Vicksburg (Miss.) Ways Company will erect a marine ways on De Soto Bayou across the Yazoo Canal from Vicksburg, and will build river steamboats and barges and do general repairing. All machinery is to be purchased. Address W. T. Campbell, Box 227, Vicksburg, Miss.

Tankers, Seattle, Wash.—The keel for the first 12,000-ton tanker to be built by the Northwest Bridge & Iron Company for the Swiftsure Oil Transport Company was not laid until July 1 on account of steel not being on hand. The company has seven of the vessels, which will be of the single-screw type, to build.

Shipyard Extension, New Orleans, La.—The Doullutt & Williams Shipbuilding Company is planning for the erection of an extension to the machine shop with new equipment, steel fabricating shop and other buildings for ship repair and construction. Two 10,000-ton floating dry docks will also be built. Horace Williams is secretary.

Shipyard Extension, Chester, Pa.—The Sun shipbuilding Company has concluded negotiations with the City Council for closing certain streets in the vicinity of its plant to allow for proposed additions. The company plans to construct new drydocks, additional shipways, with shop and construction buildings.

Bronze Propellers, Seattle, Wash.—The Doran Brass Foundry has a contract for sixty bronze propellers for the United States Shipping Board, Hog Island yard. The order means more than $500,000 worth of work for the Doran plant and sub-contractors who will do the machine work and make the iron castings.

Converting Ship to Oil-Burner, Hong Kong.—The China Navigation Company's steamer Suiyang is being converted into an oil-driven ship by the Taikoo Dockyard & Engineering Company. If this experiment proves a success the company will probably convert several others of the line as soon as they can be taken off the run.

Drydock, Chester, Pa.—The Sun Shipbuilding Company, Chester, Pa., has begun work on the basin for its proposed 10,000-ton floating drydock and hopes to have the dock completed and in operation by March, 1921. The company is building the basin large enough so that if next year's business warrants it another dock of whatever size necessary can be put in.

New Repair Plant, Sacramento, Cal.—The National Engineering & Dry Dock Corporation has been organized by George W. Ley, Max L. Gordon and Abe Raffee, of Los Angeles, and Roy Atkinson, of Santa Monica, with a capital of $500,000. They plan to build and repair ships and do a general engineering business. The location of the plant is yet to be decided on.

Shipyard to Resume, Baltimore, Md.—A. P. Vane, of Vane Brothers, ship chandlers, 602 East Pratt Street, who recently acquired the shipbuilding plant of the Delaware Shipbuilding Company, Seaford, Del., will operate it under the name of the Seaford Marine Railway Company, with plans for extensive activities. Charles R. Marvel is superintendent of construction.

Shipyard Sold, Crisfield, Md.—The Crisfield Shipbuilding Company disposed of its local shipbuilding plant to a new company represented by Egbert L. Quinn for a consideration said to be $50,000. A portion of the plant, including the machine shop, mechanical repair works, etc., recently destroyed by fire with a loss reported at $45,000, will be rebuilt by the new owner.

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Refrigerating Steamer, Birkenhead, England.—Cammell, Laird & Company, Ltd., are to build a refrigerated steamer of about 1,300 tons gross for the Union Cold Storage Company, for transporting cold meat. The vessel will be somewhat on the lines of the three Royal Mail Steam Packet Company's twin-screw steamers Dart, Doon and Devon, built in 1912, 1913 and 1914, respectively.

Luggage Steamers, Birkenhead, England.—The Birkenhead Ferries Committee will place, subject to confirmation by the Town Council, a contract with H. & C. Grayson, Ltd., for building two new luggage steamers at a cost of £100,000 each. The steamers will be 150 feet long and 50 feet beam, and will embody in their design the best type of vessel for the Mersey cross-river goods traffic.

To Recondition Steamers, New York.—The United States Mail Steamship Company, backed by the France & Canada Steamship Company, 120 Broadway, will recondition the thirteen ex-German steamers purchased from the Shipping Board; they are the George Washington, Pocahontas, Mount Vernon, Callao, Susquehanna, President Grant, America, Princess Matioka, Antigone, Agamemnon, Amphion, Madawaska and Freedom.

New Dry Dock Company.—The Dry Docks & Ship Repairs Corporation of Philadelphia, John Meigs, president, has been formed to operate a dry dock and ship repair plant on a 35-acre plot near the Reading Railroad ferries in South Camden, N. J. The company is said to have $5,000,000 ready for the work, the site has been leased for five years, and two dry docks, one of 10,000 and one of 6,000 tons, will be erected, also a marine railway.

Machinery and Tools, Weehawken, N. J.—The Lord Construction Company, 105 West 40th Street, New York, has compiled a list of machinery and tools for its new shipyard at Weehawken, N. J., to be operated in the name of the Lord Dry Dock Company. The equipment will include heavy-duty lathes, punches, shears, radial drills, milling machines, boring and drilling machines, grinders, etc. Most of the equipment will be for electric drive.

Contracts for Tenders, City Island, N. Y.—Kyle & Purdy, City Island, N. Y., have contracted with the International Petroleum Company for a 132-foot steel maintenance tender; it will have 450 horsepower fore and aft compound inverted engines, 18 x 38 x 26 inch stroke with one three-furnace Scotch boiler; also for a duplicate of this vessel with the Atlantic Gulf Oil Company. These are to be used as buoy tenders in South American waters.

Cargo Carriers, Wilmington, N. C.—The Carolina Shipyards (George A. Fuller Company) is starting work on four 9,600 deadweight tons steel cargo carriers for builders' account. The keel for the first has just been laid. Launchings scheduled at the yard include the steel steamers Hybert, 4,800 tons, on July 20, and Syros, 4,800 tons, on August 21. Two vessels not yet named will be launched in October and November, and two more in January and February, 1921, each of 4,800 tons net.

Steamships, Troon, Scotland.—Contracts for the construction of two steamships have been placed with the Ailsa Shipbuilding Company, Ltd., Troon, by the Sociedad Anonima Importadora y Exportadora, of Buenos Ayres and Punta Arenas, and Braun & Blanchard, of Punta Arenas. The new ship of the former concern will be of 4,300 tons, to cost $1,352,887, and to be delivered in December. The latter steamship will be of 3,500 tons deadweight, to cost $1,056,031, and be delivered in May, 1921.

Shipyard Extension, Perth Amboy, N. J.—The Perth Amboy Dry Dock Company, Broad Street, will build a two-story steel and concrete addition to its machine shop, 70 x 100 feet, and install new equipment. It is completing an addition to its forge shop, and has arranged for immediate operations in a new boiler, plate and angle shop; delivery of a new dry dock being built at Kingston, N. Y., is expected soon; equipment required will include electrically operated pumping units, valves and other mechanical apparatus.

Shipbuilding Plants for Sale, Detroit, Mich.—Bids on the plants of the Great Lakes Engineering Works at Detroit, Ecorse and Ashtabula, Ohio, are being solicited by the board of directors of the company. The company, which has built some of the largest and most modern freight vessels on the Great Lakes, was incorporated in Michigan in 1902 and opened its plant at Ashtabula in 1910. Since the outbreak of the war they have constructed mainly ocean-going steamships for the government. There is $2,500,000 stock outstanding.

Steel Schooner Wanted.—A Brazilian firm is in the market for a two-masted schooner of approximately 200 tons, length of keel 98 feet 4¼ inches; beam, 22 feet 9 7/10 inches; draft, 6 feet 5½ inches; with latest model crude oil motor of approximately 100 horsepower, all rigging complete; steel hull to be of best quality. Quotations and terms should cover vessel complete, delivered at Rio Grande, Brazil, and approximate time required for construction. Address Foreign Trade Bureau, Department of Commerce, Washington, D. C. Opportunity No. 32,942.

Plant Begins Operations, Fairfield, Md.—The Globe Shipbuilding & Dry Dock Company, with offices at 604 Stewart Building, Baltimore, has begun operations at its plant near Fairfield. The office and mold loft have been completed, and other buildings are being pushed. Three sections of the drydock have been delivered and two are on the way. One thousand feet of pier space and the channel leading from the main channel to the works have been completed, and the excavating of a basin 45 feet for the drydock is in progress. Machinery is being installed. E. W. Grass is special representative.

New Dry Dock, Sparrows Point, Md.—Three of a series of eight pontoons for the new floating dry dock being constructed by the Bethlehem Shipbuilding Corporation have arrived at Sparrows Point from the yard of the Whitehaven Shipbuilding Company, Whitehaven, Md. The new dock will have a lifting capacity of 10,000 and will be 350 feet long. The remaining five pontoons are being rapidly constructed by the Whitehaven plant, and it is expected to have the dock ready for service early in the fall. Bethlehem Steel officials have announced that an additional expenditure of $35,000,000 will complete their expansion programme, making a total of $85,000,000, the $50,000,000 expenditure being nearly completed. When the improvements are completed there will be about $15,000,000 invested in the shipyards; several lare ore steamers will be built for carrying Standard Oil products to Chile and return with ore for the Bethlehem Company.

PORT IMPROVEMENTS

Dredging, Canton, Ohio.—The city of Canton has voted to issue $65,000,000 bonds for dredging and improving the East Creek.

New Fireboat, Philadelphia, Pa.—A new fireboat is to be provided for the harbor of Philadelphia to cost $300,000 to $350,000.

Improving Harbor, Kingston, Jamaica.—Improvements planned in the harbor of Kingston to accommodate large steamers will cost about $1,225,000.

Widening River, Buffalo, N. Y.—The city is having plans prepared for widening Niagara River in and adjoining Buffalo harbor. G. H. Norton is city engineer.

Construction of Dry Dock, Esquimalt, B. C.—Construction of the big Dominion Government drydock at Esquimalt will start September 1. Costt, between $5,000,000 and $8,000,000.

Jetty to Be Built, Newport, Ore.—Construction work on the north jetty of Yaquina Bay will commence soon, according to the Newport Port Commission. Estimated cost, $500,000.

Dredging, Portland, Ore.—Dredging of the harbor before the Inman-Poulsen mill is planned. Material taken from the river bottom will be dumped in the low places on Ross Island.

Wharf and Shed, San Francisco, Cal.—The State Harbor Commission, Ferry Building, let contract for building a creosoted pile wharf and shed, concrete flooring to the Healy-Tibbitts Construction Company, 9 Main Street; $44,199.

Harbor Development, Hamilton, Ont.—The Hamilton Harbor Board has submitted plans for the development of the bay front involving an expenditure of approximately $20,000,000; the International Waterways Commission is considering the project.

River Improvement, Houston, Texas.—Plans for improving the lower Trinity River and Turtle Bayou, Houston, have been approved by United States Engineers, Galveston; this will open up much trade territory to Houston by light-draft steamers.

To Build Pier, Venice, Cal.—A company has been organized by C. Daly and others to build a double-deck timber and concrete pleasure pier 150 x 900 feet at Venice. About $350,000. Leads & Barnard, Central Building, Los Angeles, Cal., are the engineers.

Channel Excavation, Albany, N. Y.—E. S. Walsh, Superintendent of Public Works, Albany, N. Y., received only one bid for the excavation of canal channel in the Genesee River, Rochester, from the Stewart Company, 30 Church Street, New York; about $547,500.

Dredging, Baltimore, Md.—The Bethlehem Steel Company has applied to the United States Engineers, Custom House, Baltimore, for permission to widen one-half mile of 35-foot channel leading to the company's ore pier, from 90 to 250 feet, involving about 1,500,000 cubic yards excavation; about $100,000.

Deepening Channel, Portland, Ore.—Manufacturing and business concerns located adjacent to North Portland harbor have addressed a petition to the Port of Portland Commission asking for a channel 25 feet deep and 300 feet wide, and will very soon be acted upon.

Grain Terminals, Oswego, N. Y.—The New York Superintendent of Public Works is having plans prepared for a barge canal grain terminal at Oswego, N. Y., not to exceed $1,000,000, also for a barge canal grain terminal at New York City, cost not to exceed $2,500,000.

Pier, Warehouse, Etc., Punta, Arenas, Chile.—The Department of Public Works of the Chilean Government has approved plans for port improvements to consist of a pier for freight and passenger traffic, an esplanade and a custom house and warehouse, at an estimated cost of 2,412,000 pesos, Chilean paper currency (about $482,000), and an appropriation of 250,000 pesos for the preliminary work has already been made. Plans call for a concrete pier 885 feet long by 55 feet wide, equipped for handling of 120,000 tons of freight annually, and for a distance of 374 feet the water will be sufficiently deep for vessels of 2,000 tons.

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Dredging, Charleston, S. C.—The Standard Oil Company, Brigade Street & Southern Railway, let a contract for removing 140,000 cubic yards of sand, mud and clay in the Cooper River at the head of Drum Island, to the Atlantic Gulf & Pacific Company, Park Row Building, New York City; 24 cents per cubic yard.

Dredging, North Portland, Oregon.—The Aladdin Ready-Cut House Building Company and thirty other concerns located on the waterway known as North Portland harbor, have petitioned the Port of Portland Commission to redredge the shoaled channel to a depth great enough to permit ocean-going ships to dock.

Deepening Channel, Etc., Portland, Ore.—J. H. Polhemus, engineer of the Portland Port Commission will engage special help and prepare a survey for deepening the channel in North Portland harbor, removing dikes in Willamette slough, and other improvement work. Frank N. Warren is new chairman of the committee.

Dredging, Portland, Oregon.—Plans for improving the ship channel from Portland to the sea have been made by the Port Commission, and Lieut. Col. J. R. Slattery, government engineer, is in charge of the district. The plan will keep three of the four port dredges and two of the government dredges at work up to the middle of November.

Terminal Site, Mobile, Ala.—Plans to close out the deal for the purchase of the Hunter property on the west side of the river near One-Mile Creek for the erection of coal terminals by the Government are nearing completion. The site is to be furnished to the Government free, the City Commission having already agreed to underwrite $50,000 on the purchase price.

Canal Terminals, New York.—The New York State Legislature has made the following appropriations: $750,000 to build canal terminals and furnish facilities for canal traffic at Buffalo, N. Y.; $750,000 to build canal terminals and furnish facilities for canal traffic at New York City; $500,000 to build canal terminals and furnish facilities for canal traffic at Rochester, N. Y.

Channel Deepening, New York, N. Y.—The Hell Gate channel will be deepened to 45 feet for a distance which includes the underwater route taken by the West Side Subway as it heads for Clark Street, Brooklyn, in the East Ri er. At Hell Gate, off Hallett's Point, otherwise known as Frying-Pan Shoals, the depth will be 35 feet. Between Riker's Island and Barreto Point the new depth will be 40 feet. The contract has been awarded to the New Jersey Ship Building & Dredging Company.

Dredging, Mobile, Ala.—The city of Mobile will dredge deeper channels in front of the city wharves, in order to give the large steamships of the new steamship lines inaugurated there ample deep water loading berths. The port has completed the 30-foot channel to the Gulf project which was adopted by the Rivers and Harbors Committee August 8, 1918, the work on which started September, 1918, thus accommodating vessels of large tonnage. The total cost amounted to $8,500,000.

New Terminal, Seattle, Wash.—Smith Cove Pier B, the new public terminal which was constructed at a cost of $2,000,000, is ready for operation. This terminal has berthing space for eleven ocean-going vessels, being the largest commercial pier in the world. It is 2,543 feet long and 365 feet wide, and has a transit shed 500 feet long and 120 feet wide at the street and where the passenger accommodations will be located. Later an additional 500 feet of shed will be constructed, making the total length 1,000 feet.

Government Work

Dredging, Nome, Alaska.—United States Engineer Office, Seattle, Wash., has plans for dredging at Nome, Alaska, at an estimated cost of $18,000.

Dredging, Michigan City, Mich.—Bids for dredging in Michigan City harbor will be received by United States Engineer Office, 537 South Dearborn Street, Chicago, Ill.

Dolphin Pier, Charleston, S. C.—Specification 4228. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to build a dolphin pier 318 feet long; about $6,000.

Power Plant, Wheeling, W. Va.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is arranging to build a new power plant near lock No. 48, near wheeling.

Dump Scow Wanted, Louisville, Ky.—The United States Engineer Office will receive bids for furnishing and delivering one steel dump scow, up to noon, July 8; further information on application.

Dredging, New York.—United States Engineer Office, Room 710, 39 Whitehall Street, New York City, will receive proposals until July 24 for dredging in Mattituck River, N. Y. Information on application.

Boiler Tubes, Charleston, S. C.—Bids will be opened on July 8 for furnishing and delivering charcoal iron boiler tubes by the Superintendent of Lighthouses, Charleston, S. C. Information on application.

Dredging, Wilmington, Del.—United States Engineer Office will receive bids until 11 A. M., July 15, for dredging waterway between Rehoboth and Delaware Bays and Lewes Canal. Further information on application.

Dredging, Wilmington, Del.—The United States Engineer Office, will receive proposals until July 15 for dredging waterways between Rehoboth Bay and Delaware Bay, Lewes Canal, Delaware. Further information on application.

Dredge for Sale, Galveston, Tex.—United States Engineer Office, Galveston, will receive proposals for the seagoing hopper dredge Sabine until noon, July 14; dredge can be examined at Beaumont, Tex. Blank bids and description can be obtained at United States Engineer Office, Galveston.

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SHIPPING DEVELOPMENTS

California-Oriental Service, Los Angeles, Cal.—The Los Angeles & Pacific Navigation Company plans to inaugurate a steamship service between Los Angeles, Honolulu and the Orient. Four vessels will be placed on this run to start with, which will be allocated to the Los Angeles company by the Shipping Board.

Steamship Service, New York.—Norton, Lilly & Company, general agents of the American & African Steamship Line, have announced a new service via Suez Canal to the Red Sea and East Africa, beginning with the steamer Gordon Castle. The ports of call will be Massawah, Mombasa, Kilindini, Zanzibar, Majunga, Beira and Delagoa Bay. It is proposed to have regular sailings.

Atlantic-Pacific Coast Service, Seattle, Wash.—The foreign department of the Pacific Steamship Company has taken over the agency of the North Atlantic & Western Steamship Company, of Boston and Philadelphia. This company will establish a steamer service between Puget Sound and Atlantic ports, the first steamer calling at Wilmington and San Francisco and then going north.

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